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SCIENTIFIC AMERICAN

MISSING LINKS OF THE GOBI DESERT
By Dr. William K. Gregory

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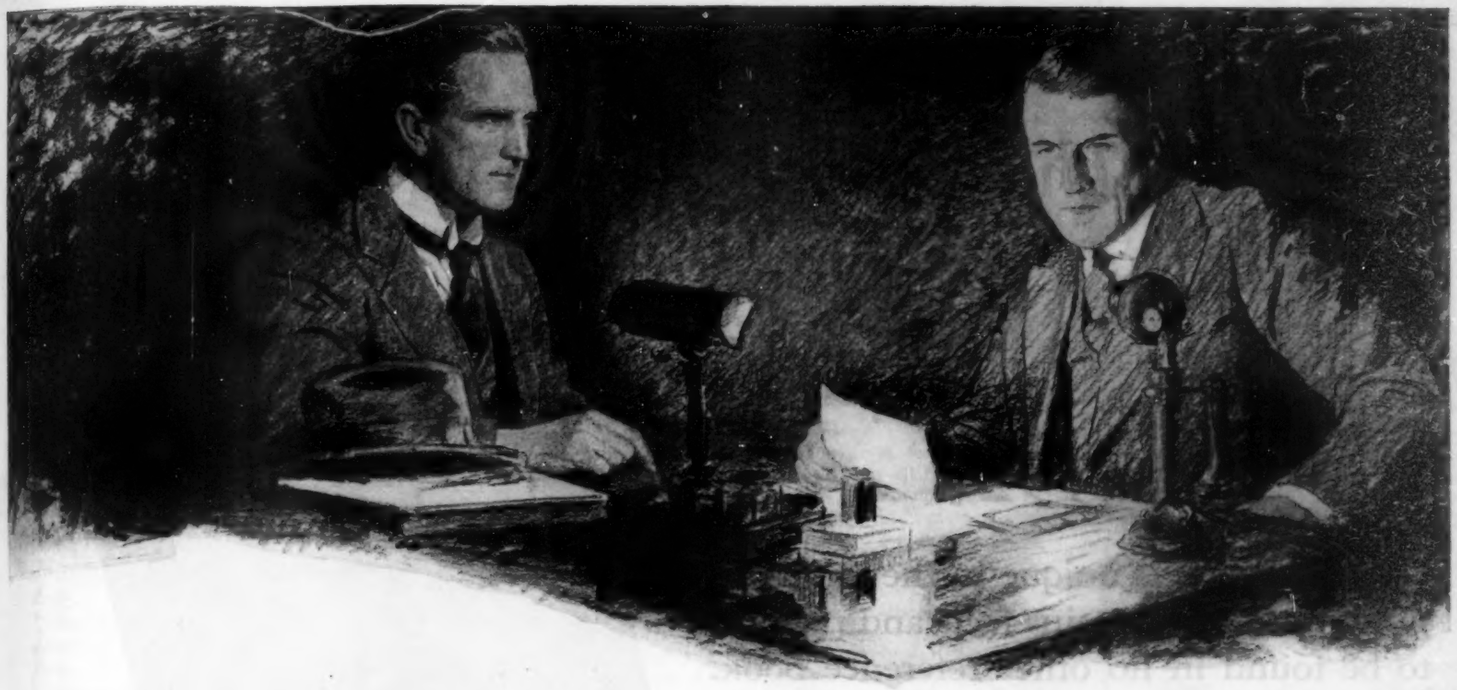

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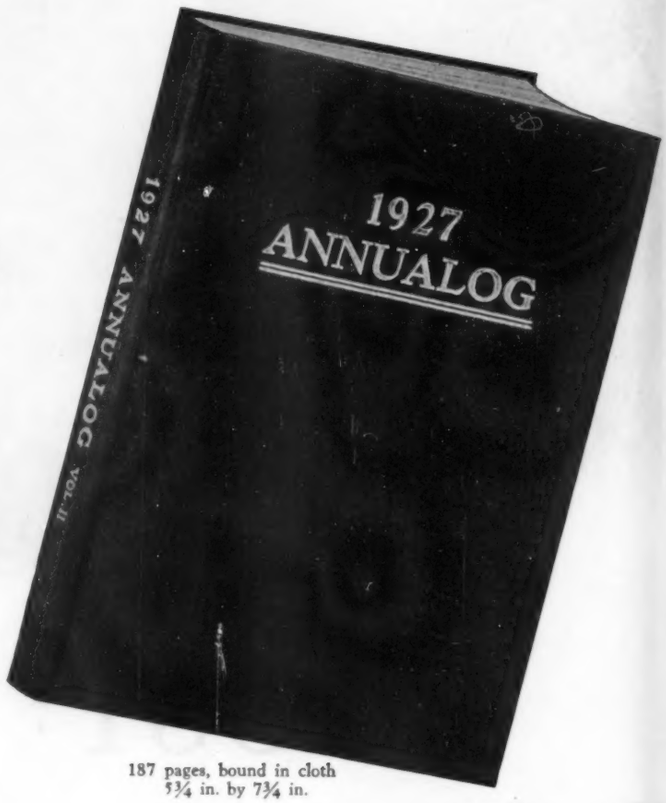

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What is the record time for a steamship crossing the Atlantic?

What useful element, first discovered in the sun, is now found on the earth?

What are hormones?

How hard does the wind blow?

Who invented the steam engine which Watt improved?

Where did the American Indian come from?

What is at the center of the earth?

How do you compute compound interest?

What weather will follow a low, slowly falling barometer when the wind is from the southeast?

How can you use your watch as a compass?

Where in America are diamonds found?

What is the one article which flag etiquette permits to be placed on the American flag?

You could answer these and a thousand more if you had the 1927 Annualog.

HERE ARE JUST A FEW OF THE SUBJECTS IT COVERS

Chemical Elements	Vitamins in Our Food
Ten Year Review of Electricity	Glass Manufacturing
Radio in 1926	Precision Weighing
Nobel Prize Winners	Electric Welding
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SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, APRIL, 1927 | *Edited by* ORSON D. MUNN | EIGHTY-THIRD YEAR

VITAMINS

MOST mothers of school children know these days—or ought to know—what Vitamins A, B, C and D are. Vitamin A promotes growth. Vitamin D also promotes growth and prevents rickets—bones that get crooked. Both of these vitamins are essential to health.

Knowledge of vitamins is not yet far advanced. New facts are being learned daily. Now it happens that many "scientific" farmers keep their cows indoors all day, bringing their food to them. This is found to pay. It is called "intensive milk production." Milk produced in this way contains enough Vitamin A but not enough Vitamin D. To produce the latter the cow needs to get out of doors into the ultra-violet light. This comes from the whole sky. It produces certain chemical effects in the cow's skin. These effects are transferred within where they permit the manufacture of Vitamin D. This is passed on to the milk.

Substitutes for sunlight have been tried, with the result that the conviction grows that the best source of Vitamin D is plain, ordinary sunlight. Keep the cows in pasture.

SARDINES

SCIENTISTS have figured out that by the year 2000 A. D. the population of the United States will be 200,000,000. That is just about the number that our land will support comfortably.

Then what? Semi-starvation and the resulting cessation of advance because everybody will be hard put to it to make a bare living? Malthus figured these questions out long ago in his classic work on Population.

What the world wants is happiness—not more population. There are two billion human beings already. Is that not enough? Why must we fill all the present "open spaces?" Is there any special virtue in mere numbers—in multiplication? France, whom many think decadent because her population does not increase rapidly, has really found the secret. The French people are said to have learned, better than any other nation, how to live happily. The only thing to be said for growing monstrous is that we might then "lick the hull of creation." But why?

OUR COVER

WHEN building the Owens River aqueduct, mentioned in the article starting on page 246 of this issue, the desert dust was often found to be so extremely fine that it was necessary to moisten it before it could be handled by the steam shovels. Our cover illustration shows the system employed.

In This Issue

Who Was Man's Ancestor's Ancestor?
Despite a widespread misapprehension, most real authorities believe man's ancestor was an ape; earlier still, a monkey; before that, *what?* Little is known, except by inference. Recently the fossils of this "great-grandfather" of man were discovered. On page 231, a world-famous authority explains their immense significance.

New York Talks to London
Of course you read about it in the papers, the day after the new service across the Atlantic was started. It was all very interesting, but what you wanted was a technical description of the inner workings of it. This, written by Mr. Dunlap, our radio editor, is what you will find on page 242.

The Farmers' Nightmare
We direct special attention to the article in this issue by Hugh Hammond Bennett on soil erosion—a subject, the importance of which is too little appreciated. The author has more expert knowledge of this subject than any man in the United States. He gives you, not theories, but facts which cannot be controverted. See page 237.

Fishes That Carry Batteries
Perhaps the oddest of all Nature's many kinds of defenses is the electric shock that a few kinds of fishes can deliver. Touch an electric fish and your arm is numbed. Few people know the facts about these peculiar animals. On page 234 it is set forth by a noted authority on fish.

MORE THAN 200 PICTURES

Complete table of contents will be found on page 295.

For Next Month

Mapping Inaccessible Alaska from the Air
Last year the Navy's airplanes flew over 10,000 square miles of rough Alaskan mountain ranges, over immense glaciers and extensive forests, mapping from the air with cameras these areas that could hardly have been mapped at all by ordinary means. And next month we shall tell about that interesting adventure.

Prehistoric Miners of Europe
Archeologists have discovered ample evidence that ancient miners, equipped with nothing better than the antlers of a stag, burrowed far into solid rock in quest of the flint which was as essential to man's early progress as iron is to ours. Next month a noted archeologist will tell how they performed this remarkable feat.

Teaching the Deaf to Play Band Instruments
It is an actual fact that in a famous New York institution hundreds of deaf pupils have learned to play band instruments—cornets, trombones, et cetera. *And* they play acceptably! Here is a story with real human interest, giving an insight into the thoughts of the deaf. Reserve next month's copy now.

Other articles on Yardsticks of Sound; Building Highways for Safety; World's Largest Artificial Lake; Australia's New Capitol; The Morden-Clark Expedition of the American Museum of Natural History; The Month in Medical Science; Radio; Astronomy.

MORE THAN 200 PICTURES

¶ **Smatterings of half-baked science you can pick up anywhere. The facts you find in the Scientific American.**

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HUMBLED

PRIDE is a bubble and ours is pricked. For long we have been wont to think of our United States as having a more nearly universal use of modern conveniences than any nation on earth. In material progress we are first and there is no close second.

So we fondly dreamed. But now come statistics—figures issued by our own Department of Commerce—showing that in proportion of homes equipped for electric service we are not first nor yet second, but sixth! Look:

Switzerland	96.5 percent
Japan	73.4 percent
Denmark	72.0 percent
Canada	62.3 percent
New Zealand	59.0 percent
United States	56.0 percent

To explain that the countries of the Old World are more densely settled than ours and that Canada and New Zealand have most of their populations in relatively small areas, is poor consolation. Ours, the world's richest nation and the birthplace of the electric industry, is not at the top of the list.

MONKEYS

EVOLUTION again! Just as we thought the thing had died down, several state legislatures introduce bills to prohibit the teaching of "any theory," et cetera, et cetera. Tennessee has had its fling and is now rather ashamed of the sickly sort of publicity it received. Now some of the other states want to have their fun.

We have no particular fear of the anti-evolutionists. We think their opposition does not amount to a hill of beans. We even think they are helping "put evolution over." This much we have said before. So let them have their fun and get it out of their systems.

UNFINISHED

"I AM incarcerated in a New York State prison, and, as it is almost impossible for me to secure a small model airplane, I would be very thankful to you if you would send me a few photographs of same that I may get better acquainted." So read a letter received not long ago by the Navy's Bureau of Aeronautics. The writer also asked for a model plane which he could use in working out an invention. The Bureau sent the photographs by return mail.

That is all the information we have so far. The story somehow seems unfinished. We are looking hopefully in the newspapers every day, however, for a front-page headline reading: "Jailbird Flies Away." Science certainly can aid people in strange ways.

NEW YORK LIFE INSURANCE COMPANY

DARWIN P. KINGSLEY - - President

A Mutual Organization—Founded in 1845 Incorporated under the Laws of New York

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Eighty-second Annual Statement

To the Policy-holders:

You, the members of the New York Life Insurance Company, owned 2,220,784 policies at the close of business on December 31, 1926.

You are a vast community of people representing every honest walk in life—farmers, bankers, tradesmen, merchants, laborers, manufacturers, employers and employees, and professional men and women—young and old—all banded together in a common enterprise for the common good.

If you and your families could be brought together, you would populate one of the largest cities in the world. What a city it would be, with every family striving to safeguard its own future through a single co-operative institution for insurance and savings!

A Prosperous Year

In 1926, this Company, which you own, wrote another chapter of progress:

New insurance over **900** **Million Dollars.**

Total insurance in force over **5¾** **Billion Dollars**

Paid to members and beneficiaries over **133** **Million Dollars,**

including over **53** **Millions in Dividends.**

You, the policy-holders, have accumulated assets of more than **1¼ Billion Dollars.** This money plus your future deposits and compound interest will eventually provide for payment of the Company's obligations to you and your beneficiaries.

We believe we are one of the companies Hon. Charles Evans Hughes had in mind when he recently said:

"I like to think of the spirit of life insurance, for it is the spirit of achievement."

Nylic Is Your Investing Agent

The fund of more than 1¼ Billion Dollars is invested in accordance with the strict requirements of the laws of the State of New York; and it plays a substantial part in the development of the nation's farms, homes, railroads and public works.

As policy-holders, you practise thrift. You invest soundly and safely. Your money will be available to you and your dependents, impressed with emergency-power, at a time when it will be needed most.

That is what Mr. Hughes meant when he said, in the address to which I have just referred, that a life insurance policy was the best guardian of the purse that had ever been discovered.

Small Average Policy

Your total insurance is impressive; but if you divide it by 2,220,784, the number of policies, you will find that the size of the average policy is only $2,590.

Of course, some members have more than one policy; and many of you are also insured in other companies. But the great majority are UNDERINSURED, as you will see.

Cash Value of Life

Fire insurance and life insurance protect values. The value of a worker's life is the cash worth of his future net earnings, usually far greater than the value of his property. The following points may help you to estimate the monetary value of your life.

The United States Government fixed $10,000 as the insurable life-value of American soldiers and sailors in the Great War, *mostly young unmarried men who had been earning small incomes or none at all.*

Recently, according to the *New York Times,* the American Statistical Association declared that the money value of the average American life (including children and adults who earn no income) is $17,500! *As an income-earner, the value of your life is much greater.*

Consider the capital required to produce income from interest. At 5%, it takes $24,000 to yield $1,200 a year—$100 a month.

How Much Insurance Is Needed?

The answers to the following questions will enable you to measure your insurance needs: What is the minimum income you will require in your old age, or if you become totally and permanently disabled; and what is the smallest annual income your family could manage on if you were taken away?

Is it $500 a year, or $1,000, $2,000, $5,000, $10,000, or more?

How much will it require to settle your estate—to pay your debts, mortgages, and taxes, including the federal and state inheritance taxes?

How much cash will be needed at your death, or the death of your partner or an official of your company, to stabilize credit or to enable surviving partners or stockholders to acquire the deceased associate's interest in the business and carry on?

Your Program

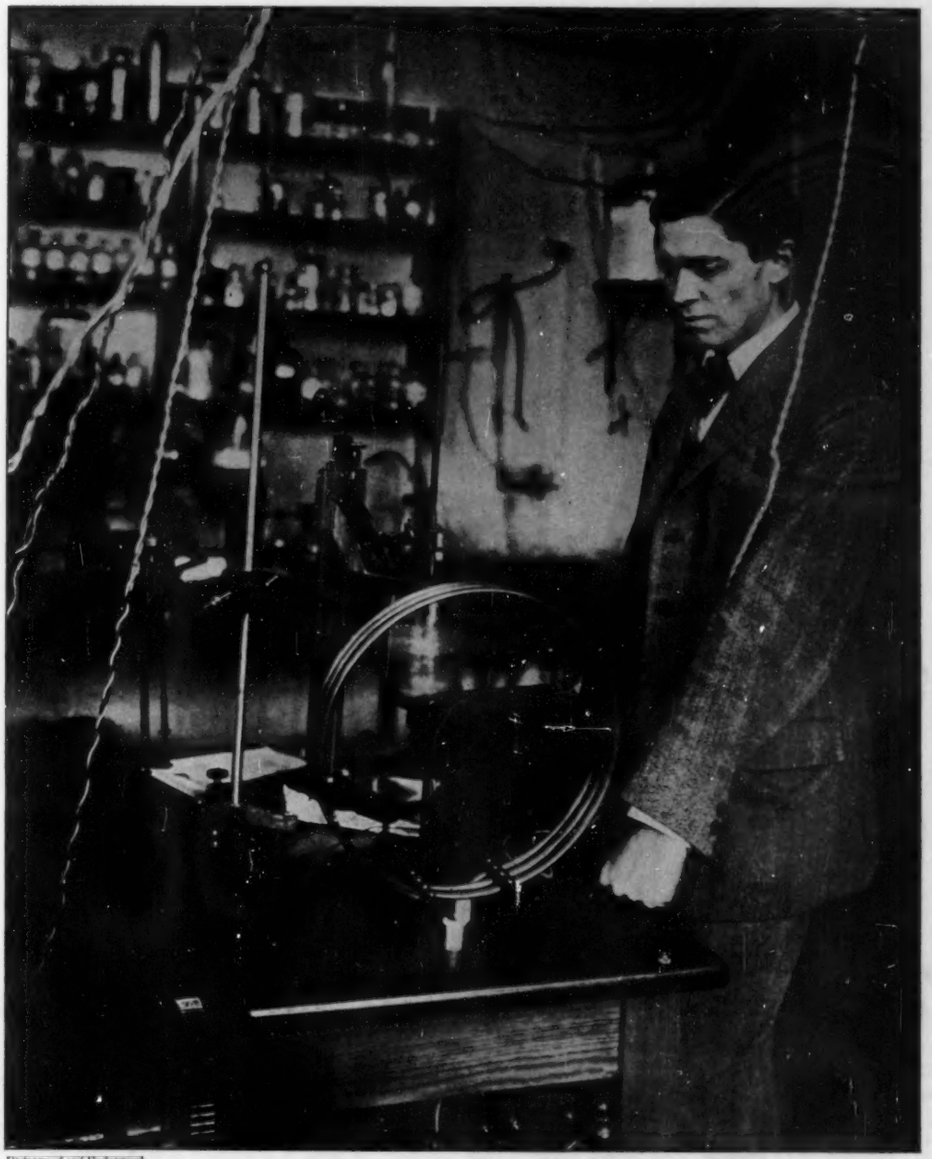
You probably have a program, because you are insured; but how does your program stand today? How far short is it of the safety mark or the mark you are aiming at? May I suggest that you figure it out for yourself, or call in one of our Agents to help you work out a plan suited to your needs, so that you may feel secure as to your own and your family's future.

DARWIN P. KINGSLEY, *President.*

Financial Summary, January 1, 1927

ASSETS		LIABILITIES	
Real Estate; First Mortgage Loans on Farms, Homes and Business Properties	$440,388,584.62	Insurance and Annuity Reserves	$1,003,297,782.00
Bonds U. S., other Gov'ts, States, Cities, Counties, Public Utilities, R.R.'s, etc	583,984,590.22	Dividends payable to Policy-holders in 1927	54,535,527.00
Policy Loans, Cash and other Assets	242,692,691.20	All other Liabilities	102,448,175.76
		General Contingency Funds	106,784,381.28
Total	$1,267,065,866.04	Total	$1,267,065,866.04

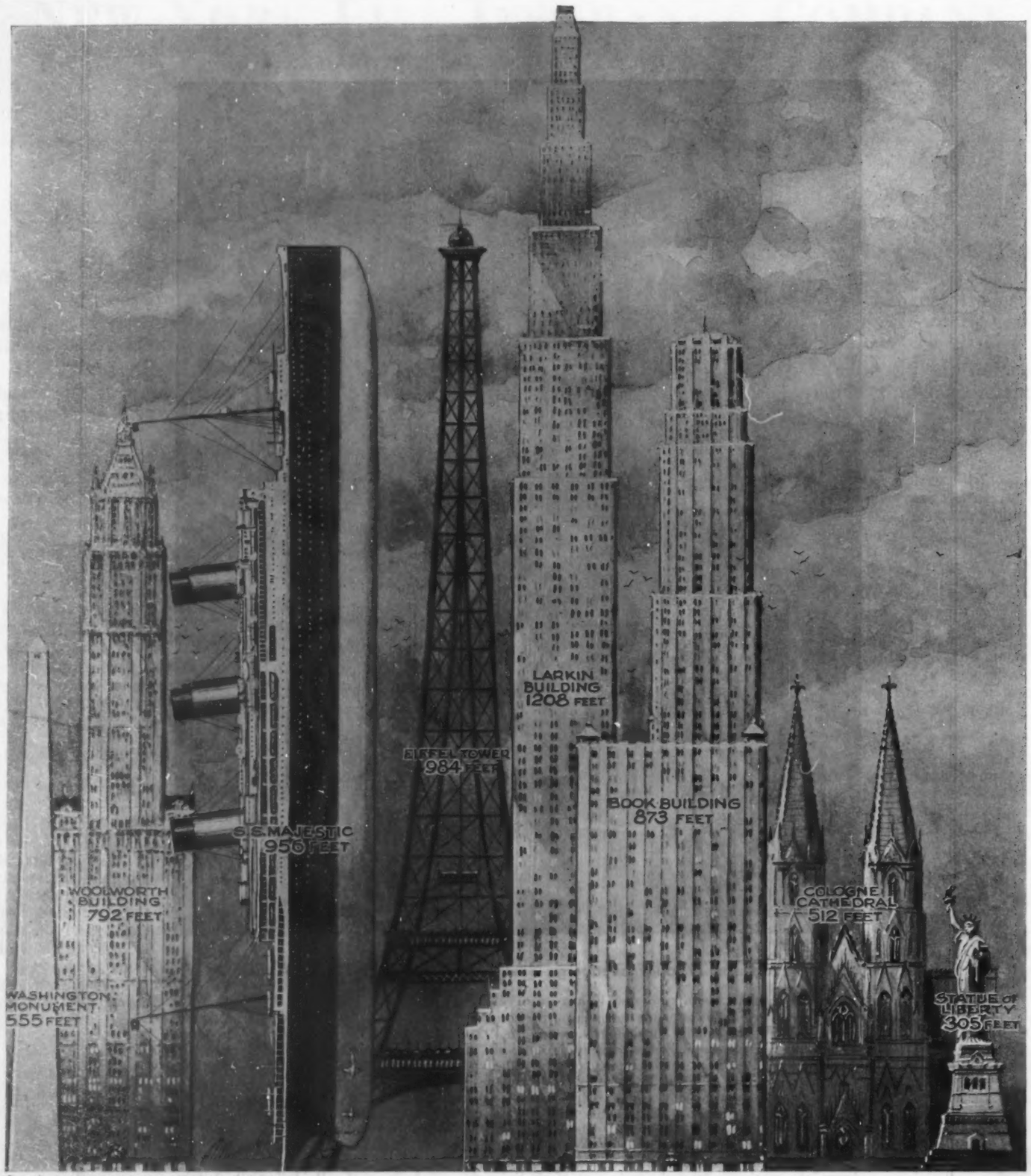
Total Income in 1926 $295,341,937.98



Underwood and Underwood

Professor Theodor Svedberg, New Nobel Chemistry Prize Winner

Professor Theodor Svedberg of the University of Upsala, Sweden, was awarded the 1926 Nobel Chemistry Prize for his valuable research on the formation of colloids. He is not merely an authority on colloids but equally in photo-chemistry. In 1923, he lectured at the University of Wisconsin; his lectures were embodied in a monograph entitled, "Colloid Chemistry" (Chemical Catalog Co., New York). This is a general survey of that rather peculiar corner of science which deals with what are known as colloids. In a colloid solution there is dispersion intermediate between that of a mechanical suspension and a molecular solution—particles about one 250,000th of an inch in diameter lying on the boundary between the two. Or, to quote Prof. Svedberg, "The central point in colloids is the particle—like the molecule in chemistry and the cell in biology. The colloid particle is a sort of intermediate between these two. In certain respects, the colloid particle possesses the properties of the molecule; in certain others, it has the complicated properties of the cell. We know," he continues, "that the main part of all living things is built up of colloids." Colloid chemistry is of deep importance in many of the industries, such as in tanning, dyeing, fermentation, the manufacture of starch, glues, gelatine, soaps, rubber, celluloids and textiles; also in breadmaking, photography, ceramics, oil refining and numerous other fields of life and industry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From a drawing made for the Scientific American by Arthur T. Merrick

How High?

The introduction of steel made possible the towering buildings of present-day cities. We must not forget, however, that both the ancient and medieval builders erected lofty structures which, in view of the fact that they were built entirely of stone, called for as much, if not more, skill than the towering buildings of today. The majestic Pharos, the lighthouse, built by the Romans at Alexandria, Egypt, about 250 B.C. was constructed of stone blocks (so the Arabs, who saw it, state) bedded in lead, and the light on its summit was probably 550 feet above its base. Not for over 2,000 years was it equalled. The Washington Monument of stone is 555 feet high. The medieval builders had even greater skill. The open-work twin spires of Cologne are 512 feet and the Ulm Cathedral spire (the tallest) rises 525 feet above the city. The Book Building (Detroit), the Larkin Tower (New York) both about to be commenced, will reach heights of 873 and 1,208 feet. A description of the latter will be found on page 267.

Photograph by J. B. Shackelford, Third Asiatic Expedition of the American Museum of Natural History

NEAR THE BASE OF THESE DESERT CLIFFS THE PRICELESS FOSSILS WERE DISCOVERED

Missing Links of the Gobi Desert

How a Handful of Fossils Has Filled a Former Gap in the Evolution Tree

By Dr. William K. Gregory

Curator, Department of Comparative Anatomy, The Museum of Natural History
Professor of Vertebrate Paleontology, Columbia University

ON a brilliant day not so long ago, black vultures were circling in the sky above the Gobi Desert. Round after round they made, patiently watching the reddish plain below. Around and below them was spread out a vast flame-colored amphitheater of bold cliffs.

Through one of the gaps in its outer rim now came a procession of black objects which moved rapidly across the plain and then came to a dead stop. Hopefully the vultures drew nearer. From the black objects sprang forth a number of active bipeds, who dragged out loot from their black caravan, started a fire and quickly erected a row of gray circular patches to be used as dwelling-places.

Soon there came forth from the group a lanky person ("Not very good picking," the vultures thought). He moved slowly across the plain to the neighborhood of the cliffs. Here he stopped and began poking around among the millions of small red stones on the surface.

Another Missing Link Discovered

Still the vultures made their rounds and still the man was at work, when, as they were beginning to grow tired of watching, he suddenly straightened up and began to run back to camp. There he evidently started a small commotion, for many of the small specks began scurrying around, variously registering excitement and enthusiasm. All this proved both meaningless and disappointing to the vultures, who soon turned their attention to more practical matters.

The cause of the commotion was nothing but a small red stone with a yellow streak in it. But the lanky person, who had X-ray eyes, saw in the red mud-clod a priceless relic, one of the most desired of missing links in all the records of life on earth.

Joyfully the rest of the American Museum of Natural History party (for it was Walter Granger of New York and his co-workers) joined in the search. Roy C. Andrews, the leader of the expedition, had already made a great haul of dinosaur eggs and small dinosaur skeletons at this place, and now they had found something of far greater value to science than any number of dinosaur eggs, even though the market value of the latter might reach 60,000 dollars a dozen!

In the few days that the expedition could stay at this remote spot, so far from their base, thousands of stones were examined and among them were a scant half-dozen that evidently contained fossil skulls of small mammals. These were eventually sent to the Museum in New York and in due time the rock was cleaned off and they were photographed, drawn and studied with intense interest.

DR. WILLIAM KING GREGORY

Dr. Gregory has devoted his life to research in evolution, chiefly on the main line of descent all the way from the Devonian age to the present, and from fish to man.—The Editor

The exceptional value of these skulls in the story of evolution will become more apparent if we make a brief survey of the knowledge of the history of mammals on earth as it stood before this fortunate discovery in the Gobi Desert.

Several scores of millions of years ago, in the Lower Devonian period of geologic time, and before the ancient Pennsylvanian coal swamps had begun to lay down their precious stores for distant ages, the only back-boned animals in existence, so far as the fossil records indicate, were fishes. By early in Devonian time some of these fishes lived in the swamps and already had lungs with which to breathe. They had also two pairs of stout paddles, corresponding to the fore and hind limbs of their descendants, the land animals of later times. Some of these well-limbed, air-breathing fishes managed to crawl out of the water and invade the land, which was yet unpeopled by any animals higher than cockroaches. For a long time the invaders had to lay their eggs in the water and the young went through a fish-like stage of development, but after further ages they produced eggs capable of development on land and so the amphibian metamorphosis was eliminated. Thus the primitive reptile stage was reached and these lizard-like forms finally dominated the whole world.

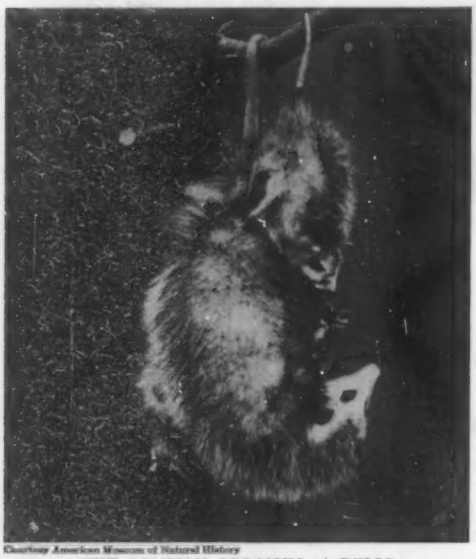
Our Ancestors Were Reptiles

In Russia and South Africa the most progressive of these lizards began to run with the body well raised off the ground and the latest ones began to look and act like mammals. We do not know exactly at what period the descendants of these progressive lizards began to delay the time of laying their eggs until finally the egg-laying was eliminated and the young were brought forth alive. But in the Upper Triassic age, when the red clays underneath the palisades of the Hudson were being laid down, the mammals had barely started on their great career. At that remote time even the powerful race of dinosaurs was in the opening chapter of its life span. None of the higher mammals had appeared and the scant representatives of the group, which have left a few fossil teeth in the Triassic rocks of Europe, were small rat-like creatures, not especially related to any mammals now existing.

For millions of years the dinosaurs and many other groups of reptiles ruled the earth and the air

and even the waters of the sea, while the mammals remained extremely small and inconspicuous. So much so that, while in all, thousands of fossil bones of dinosaurs have been found from almost all parts of the world, the fossil teeth and jaws of mammals of this epoch have always been extremely scarce.

Near Oxford and at several other places in Great Britain are certain thin strata of Jurassic age (about the middle of the Age of Reptiles) from which have been taken a number of very small jaws and teeth of mammals; these are of even greater importance than the newly-found Mongolian mammals, since they show almost the beginnings of the changes in the jaws and teeth, which prepared the way for



Courtesy American Museum of Natural History

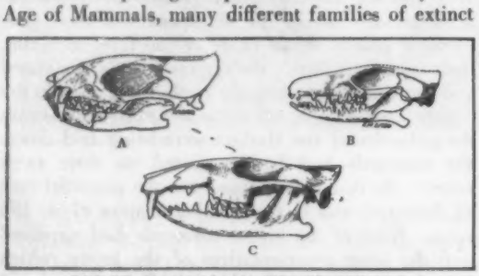
THE COMMON OPOSSUM—A RELIC

The 'possum is what paleontologists call a "living fossil," because he is a comparatively little-changed descendant of the primitive mammals that lived in the age of dinosaurs

modern mammals. From the next higher geological age, the Cretaceous, during which the dinosaurs reached the peak of their development and then became extinct, very little was known of the history of the mammals.

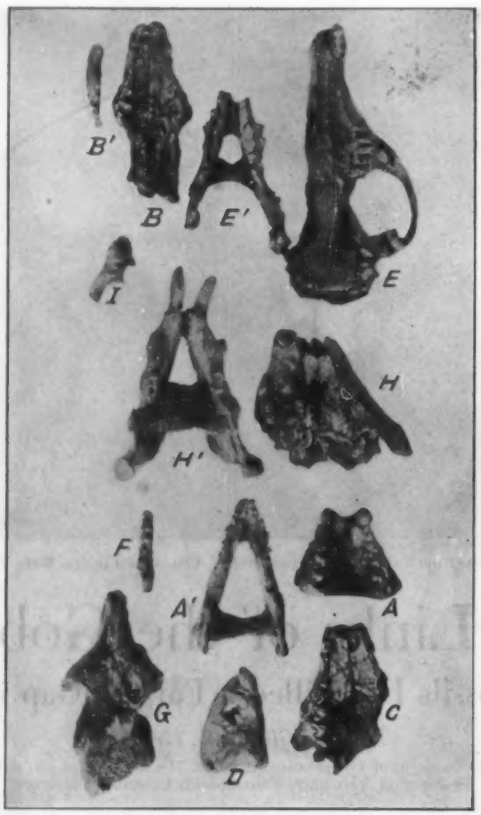
From underneath a dinosaur jaw of the Cretaceous age in Montana, Barnum Brown, of the American Museum of Natural History, once took out a small mammal jaw, which proved to be a near relative or ancestor of the existing opossum, which is accordingly one of the most ancient types of living fossils among existing mammals. The opossum and its fossil relative represent the group of marsupial or pouched mammals, but of the ancestors of the higher or placental mammals (including the vast majority of modern mammals) nothing definite was known until after the close of the Cretaceous period.

In the succeeding period, however, known as the Eocene or opening chapter of the "Tertiary" or Age of Mammals, many different families of extinct



THREE MONGOLIAN FOSSIL SKULLS

One of them, A, has enlarged canine teeth and suggests the flesh-eating mammals of later ages. The other two resemble the insect-eating mammals or insectivores which Huxley and Osborn regarded as structurally ancestral to all the higher mammals, including, of course, man himself



THE PRICELESS RELICS

They were found in cliffs of Cretaceous age at Djadokhta in the Gobi Desert. Natural size. The largest of these skulls would be no larger than that of a muskrat

placental mammals have long been known, so that it was inferred that the common stem forms from which the diversified later placentals were derived must have lived during the Cretaceous. But this common stem form was evidently absent or not abundant in the Cretaceous of Europe and North America, and no one could say definitely in what part of the world it lived. Huxley, however, a very cautious man, hazarded the opinion that these ancestral placental mammals must have resembled modern insectivores, at least in the general form of the teeth and lowly development of the brain.

10,000,000 Years Ago

Henry Fairfield Osborn and other paleontologists also taught that the ancestral placentals were insectivorous mammals which were at the same time the source of the creodonts or early flesh-eaters, of the hoofed animals and of the primates (lemurs, monkeys, apes, man). This great generalization has received strong support from the Mongolian Cretaceous mammal skulls, the discovery of which has been described above. For one of the half-dozen imperfect skulls found in the Cretaceous rocks in Mongolia proves to belong to the group of Allotheria or egg-laying mammals, but the other five apparently belong to the placental series and among these they most nearly approach the ancient insectivores and the creodonts or flesh-eaters.

The Mongolian Cretaceous mammals prove to be veritable missing links in the evolutionary chain, since they supply clear evidence as to the stage of evolution already attained by some of the mammals at that extremely remote time, ten million years ago by the most conservative present estimate. In the oldest true mammals of the Triassic age, the cheek teeth in the upper jaw were simple compressed blades which overhung and sheared past the similar blades of the lower teeth.

The Mongolian placental mammals had reached a very critical stage in evolution in which the upper molar teeth had a low cusp on the inner side of the shearing blades and each lower molar consisted first of a triangular wedge, fitting into the interspaces between upper molars, and secondly, of a spur or heel on the hinder border of the tooth which engaged with the internal cusp of the upper teeth. This is the sort of tooth which, so students of the evolution of mammalian molar teeth had predicted, ought to be found in the Cretaceous ancestors of the placental mammals. And now the Mongolian Cretaceous placentals are found to have exactly that kind of molar teeth.

Photograph by William Beebe

A MODERN INSECTIVORE

Gymnura rafflesi *of Borneo belongs to the hedgehog family and is a surviving relative of the Mongolian insectivores or "insect eaters" of the Cretaceous age of the geologist*

Popular stories and moving pictures and cartoons commonly represent man as a contemporary of the dinosaurs; but the cumulative evidence of thousands of fossils from successive ages establishes the high probability that man did not appear as such until millions of years after the last dinosaurs had vanished from the earth. In fact, all well-founded paleontological and anatomical research leads to the inference that at the time of the Mongolian Cretaceous mammals the Primates, that great order of mammals to which man belongs, had at most barely assumed the stage represented by the existing tree shrews, and would not for several millions of years produce relatively high beings, such as monkeys and apes, not to mention mankind, who by the most liberal allowance can scarcely claim to be older than the Oligocene, a far later period than the Cretaceous. But it is even reasonably safe to regard certain of the Mongolian Cretaceous mammals as representing in a general way the appearance of our own remote ancestors in the days of the dinosaurs.

THE SHARP-BLADED MOLAR TEETH

The lower teeth (below) *have high triangular crowns which fit into the interspaces between the triangular upper teeth; the "heels" on the lower teeth overlap on the inner spurs of the upper teeth. In the study of fossils, the teeth tell the scientist more than any other part of the skeleton*

The Next Great Comet Is About Due

New Knowledge May Enable Scientists This Time to Fathom Its Secrets

By Henry Norris Russell, Ph.D.

Professor of Astronomy at Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution

THERE are some astronomical phenomena which are exactly predictable in advance, such as the motions of the planets, or the occurrence of eclipses, like that which is due to happen in June. Others, like the appearance of sun-spots, can be predicted in part—we can foretell in a general way whether the number will rise or fall from one year to the next, and on what parts of the sun's surface the spots will be seen, although we cannot say just when or where any individual spot will appear. Still, other phenomena are still quite beyond our anticipation—for example the appearance of conspicuous comets.

In a science as exact as astronomy is justly reputed to be, this last fact is really surprising; but the reason for it is not far to seek. The apparent contradiction arises, not from any real lawlessness or uncertainty in the motions of comets, but in the limitations of our knowledge. Bright comets are actually very numerous—there must be hundreds, if not thousands of them, which belong to our solar system and return to perihelion at regular intervals—but their periods are almost always long. Only in the single instance of Halley's Comet has a *conspicuous* body of this sort been seen at more than one return. There are plenty of other periodic comets, but they are all faint. The brighter comets—always excepting Halley's—therefore come unheralded, not because they are new arrivals, but because their last return happened so long ago that there is no record preserved of it—or, at least, none accurate enough to enable us to predict the return.

There has been no comet conspicuous to the naked eye in our northern latitudes since 1914—although there were half a dozen or more of them in the seven years before that. On the "law of averages," another might be expected to show up pretty soon; but it is worth remembering that, in accordance with this law, a long run of barren years does not really increase the chance of the appearance of a bright comet in the coming year.

A simpler instance explains the situation. Suppose that we were tossing a coin which was itself perfectly balanced so that it was equally likely to face "heads" or "tails," and that nine heads have come up in succession, what is the chance that tails come up next time? Just an even chance, as in any other case. It is perfectly true that, out of a very large number of sets of ten tosses, we should get ten heads or ten tails, only once in 1,024 times, so that to get a run of ten tails is a very improbable occurrence. But, under our assumed circumstances where tails had already turned up nine times in succession, the greater part of the things that make up the improbable event has, by our supposition, already happened. There is but one chance in 512 that nine tails will come up in nine successive throws; but if this has just happened, only an even chance—one in two—of a tail coming up on the next throw is required to make up the thousand to one chance of a run of ten.

It is not a sound use of the principles of probability, therefore, to say that because a long interval has gone by without the appearance of a bright comet, it is more likely than usual that we will see one in the next year or two. The chance for each particular year is no better; but sooner or later the adverse run of luck must cease, and some new bright comet, visible with the naked eye, will appear.

When it does, we shall be able to study some of its characteristics with a fuller understanding than was possible a decade and more ago—especially its light and its spectrum.

For more than a century, it has been known that there was something peculiar about the luminosity of comets. They brighten up much more rapidly as they approach the sun, and fade away far faster as they recede from it than a planet would do. After making allowance for the varying distance from the earth, (which is a very easy thing to do), it is found that a planet, when its distance from the sun has diminished to half its original value—as may actually happen among the asteroids—has increased just four-fold in brightness. This is what one might expect, for at half the distance sunlight is four times as strong, following as it does the familiar inverse square law. But a comet, when its distance from the sun is halved, usually gives out not four, but fifteen or twenty times as much light as before, and sometimes even more.

Along with this great increase in brightness goes usually an equally remarkable growth in size of the comet. The central nucleus does not change much; but the head—the hazy glow of light which surrounds it—increases in actual diameter; and the tail, usually inconspicuous or absent when the comet is far from the sun, grows longer and longer as it comes nearer.

What Is "Resonance Emission"?

It is evident that something is emitted from the central parts of the comet, as it approaches the sun, which expands outward in all directions, forming the head, and then streams off, away from the sun, to create the tail. The quantity of this luminous stuff in the comet increases rapidly as it approaches perihelion; and since the sunlight which falls on it is also stronger, the great increase in its brightness is explicable. The spectroscope shows us that some of the luminous matter in the head and tail is probably dust, for it reflects sunlight, and gives us a spectrum showing the familiar Frauenhofer lines. But besides this there must be a good deal of gas present, for the spectrum also shows, often as its strongest feature, bright bands which are identical with those produced in the laboratory by familiar gases—nitrogen, cyanogen, and carbon-monoxide—when a high-tension discharge is passed through them in vacuum tubes.

These gases are therefore present in the comet, and they are of just the kinds which one might expect, for they are what used to be called the "permanent gases"—those which remain gaseous at very low temperatures. These pressures, among the material which exudes from the denser parts of the comet when these are heated by the sun, need cause us no surprise. But what makes them shine as they do? We can see no way at all in which electric currents could be set flowing through the excessively rarified gases of a comet's head or tail, as they flow in a discharge tube in the laboratory. We must seek for some other mode of excitation—and the probable nature of this has very recently been found.

Within the last few years, we have gained at last a good idea of what happens when a spectral line is produced, whether by an atom or a molecule. In the atom, one of the electrons which circulate about its nucleus shifts from one orbit to another. In the molecule, conditions are much more complicated—an electron orbit may change, the nuclei of the two or more atoms which compose the molecule may be set into a more or less violent state of oscillation, alternately approaching and receding from one another, and meanwhile the rate of rotation of the molecule as a whole may also change. This sounds like a complicated affair; and so it is. With so many possibilities of change, it is no wonder that the actual changes are very numerous, and the spectrum very complicated—full of fine lines which are packed together to form the bands which our spectroscopes reveal.

If a molecule is in its "normal state," as it is in a cold gas, it can absorb the light corresponding to the lines of certain of these bands, and thus be put into a state of higher energy. Such an "excited molecule" is now in a position to change to still another state and absorb new bands; but it is usually more likely that it will simply drop back to its original condition, unloading its excess of energy and giving out light of just the sort which it previously absorbed.

A mass of gas, then, isolated in space and illuminated by sunlight (for example) would absorb energy from the sunlight, producing new dark lines or bands in the solar spectrum as seen by an observer looking through it, and release the absorbed energy by radiation of these same kinds of light in all directions, so that when viewed transversely it would give a bright-line or bright-band spectrum.

Such "resonance emission" would show, not all the bright bands which we might get in the discharge tube, but only those which could be absorbed by the atom in its normal state.

Recent studies have shown that this is just what happens in the comets. All the cometary bands, so far as our present studies go, are "resonance bands" of just the type described. It appears very probable therefore that the peculiar spectrum of a comet is excited by the direct absorption of sunlight by the molecules of the cometary gases.

One apparent difficulty remains. When Halley's comet transited across the sun in 1910, it was apparently perfectly transparent and no lines appeared in the solar spectrum. This looks bad for the theory at first. But when calculations are made of the actual amount of light which the comet sent out—enough to make it conspicuous on a dark sky, but not in moonlight—it is found that the amount of energy which would have to be absorbed from the sun's light to keep the process going was but a very small fraction of the whole amount available for absorption, and the lines provided by the comet, although theoretically present, may well have been too faint to have been seen.

One strange fact remains: many of the cometary bands are due to ionized molecules of nitrogen, or carbon-monoxide, from which one electron has been removed without breaking up the molecule. A comet's tail and even its head, are so very rarefied that once a molecule had lost an electron it would stand a very poor chance indeed of picking one up again. But to pull the electron off in the first place takes a lot of energy; and just how so much energy can be fed into individual molecules in a comet we have as yet no idea. Perhaps the next bright comet, when it comes, may help us to find out.

Fishes that Can Shock You

Electric Rays, Electric Eels, Electric Catfish and Some Other Fishes Deliver Strong Electric Shocks. How the Electricity Is Generated Is Not Yet Thoroughly Established

By Professor David Starr Jordan
Chancellor Emeritus, Leland Stanford, Jr. University

"In only a few of the fishes is electricity generated in sufficient amounts to thoroughly protect the organism," says Prof. Henry Fairfield Osborn in "The Origin and Evolution of Life" (Scribner's, 1923). "It develops through modified body tissues in the form of superimposed plates (electroplaxes) separated equally from one another by layers of a peculiar jelly-like connective tissue, all lying parallel to each other and at right angles to the direction of discharge. The electric organ is formed from modified muscle and connective tissue and is innervated by motor nerves. The physical principle involved is that of the concentration cell, and the electrolyte used in the process is probably sodium chloride. The theory is that at the moment of discharge a membrane is formed on one surface of the electroplax which prevents the negative ions from passing through while the positive ions do pass through and form the current. The strength of the current varies from four volts in Mormyrus up to as much as 250 or more in Gymnotus. . . ."

IN the winter of 1882, when the present writer was at work on the fishes of Key West, a tourist came to his office, bearing a small ray or skate of which he told a curious story. Seeing the little fish close to shore, he stabbed it with a pocket knife. At once he felt a sharp shock like that from a Leyden jar, which, for the moment, paralyzed his arm.

So he brought the fish to me. It belonged to the family of torpedoes or electric rays, being one of the smallest kinds of these fishes, *Narcine brasiliensis*. It is locally known to the Bahama and Key West fishermen as numb-fish or cramp-fish, and to the Spanish as *entemedor*. These fishes, the torpedoes or electric rays, are very much like the ordinary skate in appearance, but softer in body and more rounded in form, the flesh being very watery and the skin everywhere perfectly smooth. Electric rays are found in all warm seas, mostly near the shore. The two species, rarely found in the United States, *Torpedo occidentalis* of the Atlantic Coast and *Torpedo californicus* of the Pacific are the largest of the group. They reach a length of three feet and a weight of a hundred pounds or more. Both species are black in color and both are rare and seldom or never used as food.

In all the torpedoes the electric organ is the same in structure. It consists of a large patch of six-sided honeycomb-like cells, "vertical hexagonal prisms," some 400 in all, in the larger species. These are placed under the skin on each side of the head, below and behind the eye, and covering the base of the enlarged pectoral fins. These are modifications of muscle-cells, and each is filled with "a clear, trembling, jelly-like substance."

The torpedo yields a quick, sharp shock when touched, benumbing an enemy for the time being. The shock is well carried along a metallic conductor, such as a knife or spear. It is said to have the qualities of magnetism, "rendering the needle magnetic and decomposing chemical compounds." However disconcerting to one who feels it, it is not dangerous. The exercise of this power soon exhausts its possessor and a period of rest is needed.

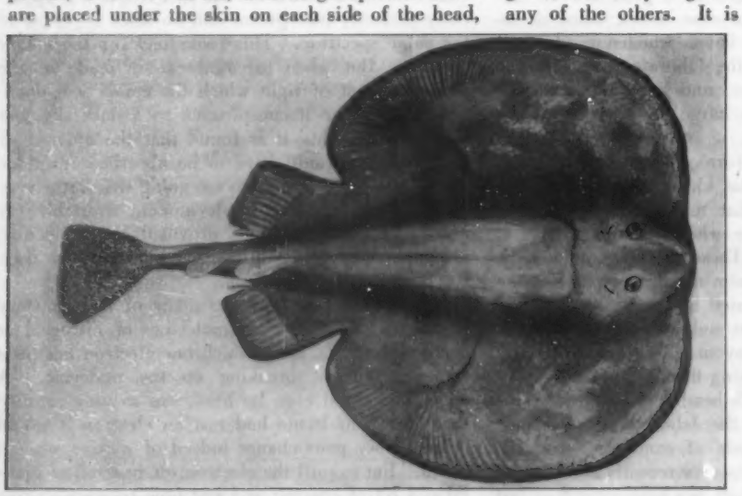
Very different from the torpedo is the electric catfish of the Nile, *Malapterurus electricus*. It is a short, stout, fatty fish with perfectly smooth skin, the fins small and lacking the spines so conspicuous in most catfish. The usual barbels are present but short and the gray-brown back and sides are marked by numerous, irregular black blotches.

The electrical apparatus of this fish is composed of small structures hidden under the surface of the skin along the whole body. They are thickest on the belly and consist of "rhomboidal cells of a firm gelatinous substance." Their origin, as in other cases, is from modification of ordinary muscular cells. The nerves supplying the electric batteries are much larger than those which pass from the spinal cord for any other purpose.

A third type of electric fish, the spotted star-gazer, *Astroscopus guttatus*, is very different from any of the others. It is a small but robust fish, about a foot long, something in appearance like a sculpin or a toad-fish, but not nearly related to either. Its head is large and flat on top and the chunky body is covered with small scales. Its color is dark, especially along the back and sides and there are three black stripes along the tail. The fins are mostly black, with white trimmings. The upper parts of the body are covered with small round white spots.

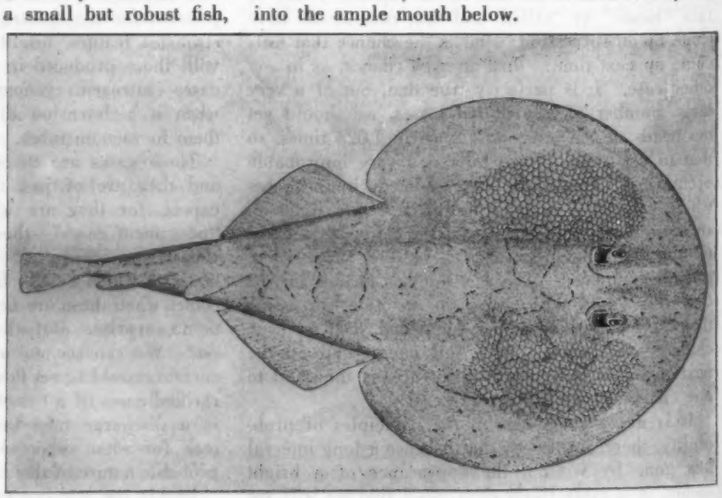
A remarkable feature of the whole family of Uranoscopidae or star-gazers, is the square box-like head, with the small eyes on the top so that the fish cannot look sidewise.

Behind each eye, hidden under a patch of smooth skin on the bony head in one species, is a small electric battery. The anatomy of this battery has been studied in much detail by Professor Ulric Dahlgren of Princeton University. The nature of the electric organs is entirely peculiar. They are made up of a series of thin layers called "electroplaxes," separated from one another by a jelly-like fluid. The electric shock given by these must be much less severe than that of the torpedo, but of this species we have few records, as the species is rather rare, and the fish lies along the shore half buried in the sand, from New Jersey to Georgia. There are numerous species of star-gazers on the coasts of Japan and in Europe, but there is no record that the bare skin behind their eyes conceals a battery. As these fishes are carnivorous, the shock from the electric cells may stun small fishes so that they fall into the ample mouth below.



CALIFORNIA TORPEDO OR ELECTRIC RAY

Torpedo californicus, from Monterey Bay, California. The ray belongs to the subclass Elasmobranchii or cartilaginous fishes, so-called because the internal skeleton is not bony but simply partly calcified cartilage. Sharks belong to this class



NUMB-FISH, WITH ITS ELECTRIC CELLS

From Pensacola, Florida. About one-third natural size. This is the fish, Narcine brasiliensis *(Henle), which gave the Florida tourist the surprise of his life when he stabbed it with a knife (see narrative at the beginning of the accompanying article)*

The electric eel *(Electrophorus electricus)* of the rivers of Brazil and Guiana, is the most highly endowed of all fishes in electric powers. It is not however an eel, resembling eels only in its elongate snake-like form. In its actual make-up it is more like a long bodied cat-fish, although without beards or spines.

In *Electrophorus*, the organs in question are in two pairs, each made up of a prodigious number of minute cells, far smaller than those of other electric fishes. One pair of these is on the back of the tail, the other on the anal fin.

In Brazil, the electric eel is said to reach the length of six feet. The shock it gives, although not dangerous, is benumbing, and stories are told of horses being paralyzed while fording streams, and coming in contact with these powerful batteries.

In his great work on the natural history of fishes, Dr. Marc Elieser Bloch (Vol. V, 1787) gives an account of various experiments on the living electric eel or puraque, as sent alive from a river in Guiana to Mr. Williamson of Philadelphia. A description of these experiments was published in the *Philosophical Transactions*.

Twenty different experiments are described in detail. These show that the fish, when absolutely at rest, gives no electric shock. It is irritated by a touch and, the more excited or "angry" the fish becomes, the stronger the shock. The shock is greatest when the fish is in the water, and grows less in captivity; the shock may be felt at some distance in the water; the shock is feeble when the fish is dying and ceases when it is dead; it is communicated along metallic or other good conductors of electricity; it will not pass through glass, silk or other non-conductors; it stuns small fishes which may touch or even approach the electric fish, and these dazed fishes are usually soon devoured.

It is claimed that when the fish is touched by two pieces of metal an electric spark may pass between them. This observation may need verification. One observer adds that twenty-eight persons, holding hands in a circle, received each an electric shock like that from a Leyden jar, when the first in the series touched the electric fish.

It is certain that in electric fishes the shock has some connection with the nerves of the muscular system. Although the electric battery is quite different in structure in each of the four types of electric fishes, these having no relation to one another, yet in every case it seems to arise from the muscular system. In one case is electric power found in connection with luminous spots or areas, "the cold lights of the sea."

The batteries of the electric catfish and the star-gazer are doubtless weaker than in the electric eel and the various torpedoes or electric rays. In the electric catfish the small cells diffused under the skin all have electric powers, while in the star-gazer the electric plates are concentrated under the skin in a small area on the top of the head. In all four forms the influence which called these structures into being, must have worked differently on each of the four different types.

A few broad considerations arise from this review of electric fishes. The general function served by the different types of batteries is evident: stunned fishes serve as food. It is also apparent that no important service to mankind can be contributed by these batteries.

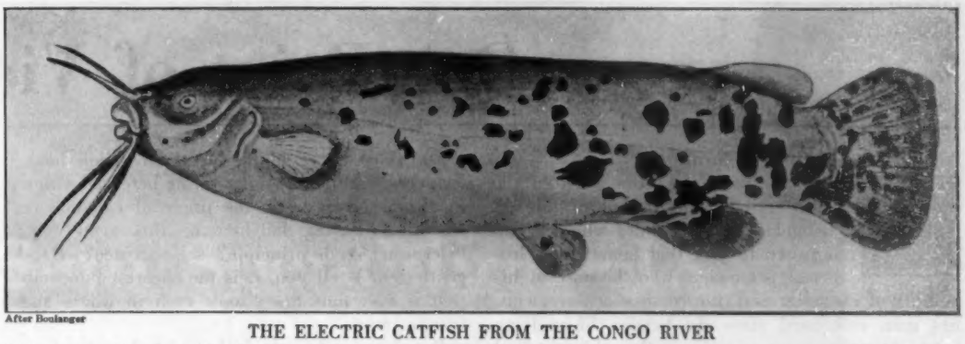
The fact is that the four types of battery have nothing in common except the presence of a jelly-like fluid in each cell, which causes peculiar effects on the nerves of animals which touch or come near the fish which bears them. To explain this power demands a much more elaborate study than has yet been given to these animals.

What we mean by "explain" is, to define a given phenomena in terms of human experience. In this sense, electricity itself has never been explained. We know a great number of its manifestations. We know how to accomplish a vast number of results by using its operations to serve our purposes. We can trace certain relations between lightning and friction on amber, the rubbing of a cat's back, the magnetism of iron or the ways of electrons. But not one of these can be "explained" in the sense in which we explain matters of dynamics. These phenomena are all related to the lighting of a city or the sending of messages around the earth, and perhaps to the maintenance of our health. But their connection is enveloped in a mystery deeper than that which surrounds most familiar objects.

We have no evidence from geology as to how the electric powers of fishes began. Three fossil species, allied to torpedo, have been recorded from Europe, these recognizable from detached vertebræ in rocks of the Eocene Epoch. The embryology of these fishes should give some clue as to the development of electric cells. But I know of no studies which have thrown much light on the stages these structures pass through.

It is a significant fact that in one group only, the electric rays or *Torpedinidæ*, is every known species provided with a battery. Of these electric rays there are about twenty species in different parts of the tropical and semi-tropical seas. These are of various sizes, from one to four feet in length, but all are provided with structures alike, as far as ordinary inspection shows. In these the electric cells are larger, their anatomical structure is more evident, and perhaps it is simpler than in any of the others.

The effect of a shock from an electric ray is almost exactly like that of a Leyden jar. Still, one can hardly explain the anatomy or the physiology of an electric fish in terms of the Leyden jar. That these cells are transformations of muscle cells seems to me probable, but I have no way of reducing this conception to terms of other human experiences.



After Boulanger

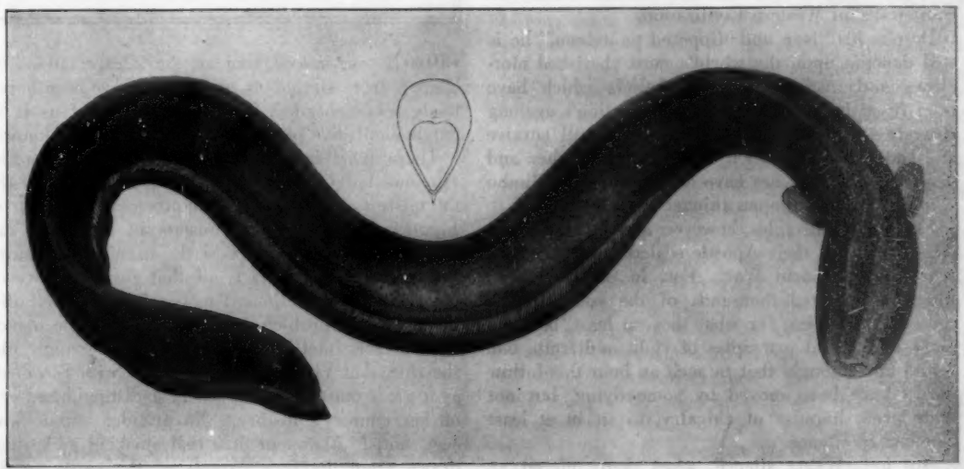
THE ELECTRIC CATFISH FROM THE CONGO RIVER

Malapterurus electricus (Gmelin) is described on the opposite page. Its electrical apparatus consists of modified muscular cells over the whole body. The electricity stored or generated in these "batteries" is evidently controlled by the nerves

Drawn from life by Dr. R. W. Shufeldt

THE STAR-GAZER, ANOTHER SHOCKING FISH

Astroscopus guttatus is still another type of electric fish. It derives its name from the unusual position of its eyes—on top of the head. Behind these organs are two electric batteries. These are described in the text



Cavenne, after Bloch

ELECTROPHORUS ELECTRICUS, THE ELECTRIC "EEL"

This Brazilian fish is not a true eel, the resemblance being superficial. It is rather large and can deliver a stronger shock than any of the known electric fishes, but its shocking powers have, nevertheless, doubtless been exaggerated

Our Point of View

The "Debunkers"

NO; you will not find the word in the dictionary—it is of recent origin. A "debunker" is a creature who sets out to prove to you that some great historical personage, who, because of his nobility of character and transcendent achievements, has been enthroned upon the heights of undying fame—to prove to you, we say, that this national hero was "not so much of" a hero; that he was in reality just such a man as any John Jones or Billy Smith among us. Your "debunker" will tell you that George Washington, for instance, could drink, swear, ride to hounds, play cards, gamble, was rather foppish in dress, and was not above a gentle intrigue (quite harmless, of course) with another man's wife.

That is "debunking." Here it consists in taking the supposed "bunk" (sham, pretense and false values) out of the national estimate of the most revered and beloved figure in American history.

Not everyone can be a "debunker." To play the part calls for a man who, whatever his other qualifications, must be distinguished by a hitherto unknown brand of good sportsmanship.

But what are the motives which prompt a man to start "debunking." They may be many and mixed; but to us they appear to be mainly two; self and pelf; self, as expressed in an unquenchable thirst for notoriety; pelf, because the "debunker" is well aware that the morally decadent half of the world will wallow in any puddle of sensationalism, be it never so muddied, and will gladly pay the price of admission.

Moreover, there is a certain type of degenerate who, looking out upon the world with the jaundiced eye of jealousy, is filled with unholy glee when someone comes along, carrying a pailful of innuendo, slander, or downright mendacity, and proceeds to besmirch the character of the nobler men, past and present, whose honorable and successful lives are a standing rebuke to his own pitiful self. From such as these, the "debunker" knows that he will draw forth rapturous applause and, incidently, the inevitable profits of a "best seller."

"Debunkers"! The breed is not so very modern, though the term may be. The great original "debunker," the High Priest of this precious cult, in spite of twenty-five years of his destructive activities, is still shaking his cap and bells as the self-elected court jester of Western Civilization.

Despite his "lean and slippered pantaloon," he is still dancing upon the world's most cherished moralities and institutions—upon beliefs which have been fused in the crucible of Civilization's agelong struggle—well-tempered beliefs, which will survive and sway mankind, when this flippant laugher and his hollow insincerities have dropped into the limbo of useless and forgotten things!

None of his disciples, however, may hope to reach the heights that their Apostle scaled in the opening years of the World War. For, in the very hour when unnumbered thousands of the youth of his country were dying for what they, at least, believed to be the eternal principles of right and truth, one would have thought that in such an hour this fellow would have been moved by some dying, but not quite dead, impulse of chivalry, to sit in at least momentary silence.

Not he! What! silence, when there offered an opportunity to "debunk," so sensational and publicital that the world would never see its like again?

So, above the sobbing breath of dying boys in Flanders, and the moaning of the bereaved at home, there was heard again the jingle of cap and bells and the cackling laughter of this aged egotist: "Heroism? high principle? self-sacrifice? Ha, ha, gentlemen, I tell you, it is the sheerest buncombe."

It is ever thus that "fools rush in where angels fear to tread!"

But, let the Apostle look to his laurels; for we have among us today the arch-interpreter of history—the greatest historical debunker of them all. Most prolific of pen-wielders, he will write you an outline of history overnight, and, with an avalanche of words, will sweep your cobwebbed mind clear of your cherished opinions, and prove to you that all previous interpreters of history are unbelievably wrong. Gibbons? Pouff! Mommsen? It is to laugh! Green? Well-meaning, but ineffectual! He will tell you, indeed, that all the interpretations of history, from Herodotus to Ferrero, have been hopelessly muddleheaded. Henceforth, history as it is taught shall give place to history by one who knows.

There lived in the nineteenth century a certain gracious lady who found herself, as a girl of 18, the mistress of the greatest empire of modern days. Instructed by the able ministers of her time, she set herself from the first to the mastery of affairs of state, and particularly of that form of government known as a limited monarchy. So well did she grasp the problem, and with such a fine blending of tact, intelligence and queenly strength did she rule, that Victoria has taken rank with Elizabeth as a great outstanding figure in a distinguished era of her country's history. No grander tribute was ever paid to a woman than that amazing gathering, drawn from the four corners of the earth, to do homage at her funeral to the worth of the deceased sovereign.

But in the eyes of the "debunkers" ("garbage historians," Solicitor-General Beck calls them) Queen Victoria was handicapped by an over-earnest belief in certain immemorial, but today, sadly out-of-date virtues, such, for instance, as marital fidelity, love of home, parental oversight, filial obedience, and other old-fashioned principles and practices. Moreover, was she not as greatly beloved for her domestic virtues as she was renowned for her wisdom and moderation in the great affairs of state?

Now, here was a situation that was sure, sooner or later, to commend itself to some inspired "debunker." The proposed victim, it is true, was a woman and was numbered among the dead—the dead, of whom the Romans, with a fine sense of decency and honor, exclaimed: "De mortuis nil nisi bonum"—(Nothing but good regarding the dead)!

But no such considerations restrained a certain chivalrous knight of the new cult, who lately favored the world with a book in which he "debunked" Victoria. Apparently, he would have us believe that this noble lady was merely a short, fat, stubborn and petulant German hausfrau, prudish, self-righteous, and, well, just a very ordinary and prosaic little woman. Faugh!

Except in the world of art, the Victorian age was one of the most brilliant in the history of the English people. But because the Queen insisted on a morally clean court, and set an example of those domestic moralities which have been given high honor, in precept if not in practice, in every age throughout the centuries of civilization, the "debunkers" of morality have chosen the term "mid-Victorian" as the last word of contempt for those who believe there is an impassable gulf between love and lust, loyalty and license, and who believe that chivalry to woman and her safe-guarding are among the invariable and ineradicable characteristics of a gentleman.

Anyone who ponders over the tendencies of the times will have noted with profound alarm that there has been at work for some years, and is feverishly at work today, an effort to "debunk" the code of morals that, hitherto, has governed the life of the American people, particularly in regard to the relation of the sexes. To say that the origin and moving spirit of this crusade is Oriental does nothing to soften its sinister significance. Its tragic portent for the future lies in the fact that it has captured certain great institutions, which, though intended primarily for entertainment, are also most powerfully educational. They are Fiction, the Drama, the Press, and last, for the masses and the children, the most powerful educational influence of all—the Motion Pictures.

Here, at first quietly and tentatively, but today, openly and with brazen effrontery, a flood of sensual filth is being let loose upon the American people, so foul (witness the published reports of certain recent notorious divorce cases) that any clean-minded man or woman can regard it only with a sense of acute moral nausea!

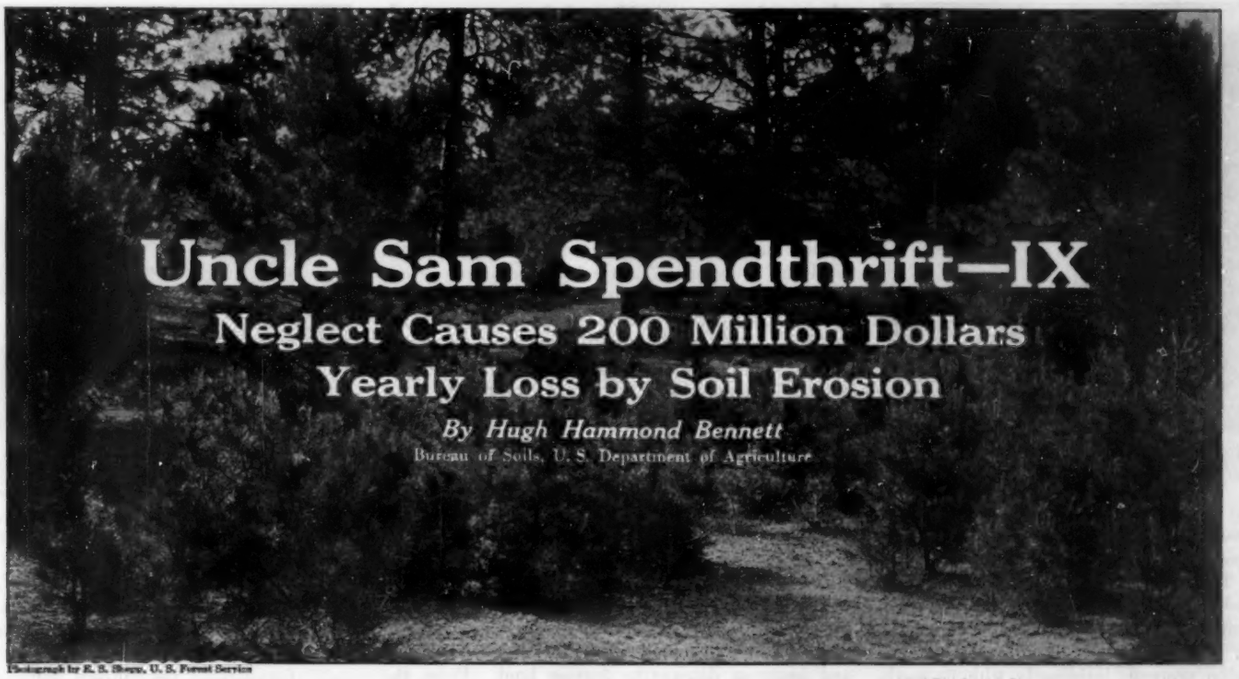
This "debunking" of the moralities aims of course at profits, huge profits, by pandering to the pitiful weaknesses of human nature. It seeks to "debunk" the American code of morals by ironic laughter. The cherished terms which meant so much to our forefathers; marriage, wife, husband, love, domestic virtue—how persistently are they made the butt of sorry jest in the "best seller" novel, in the sex-problem play, and in that unspeakable abomination, the "tabloid paper."

Whither Are We Drifting?

Social science comes within the purview, surely, of a journal such as ours. Therefore, we feel that no apology is necessary for giving our editorial page to the discussion of the most serious social crisis that ever confronted the American people. Conditions are such that they might well bring the forefathers of the nation from their very graves to pass through our streets and cry: "What manner of people have ye grown to be, that ye permit such foul abominations to go unchallenged in your midst!"

It is reassuring to note that the stage, backed by the municipal authorities, is setting out to clean house.

Furthermore, the decent people of all lands will endorse the action of the judge and jury who recently decided that the terms "liar, coward and foul fellow" were an appropriate description of the craven who dared to "debunk" the character of Gladstone, one of the greatest statesmen of his country, by accusing him of indecencies, of which he was able to offer not a scintilla of proof. The epithets were applied by the son of the dead statesman. They are capable of a wider application.



Uncle Sam Spendthrift—IX

Neglect Causes 200 Million Dollars Yearly Loss by Soil Erosion

By Hugh Hammond Bennett
Bureau of Soils, U. S. Department of Agriculture

Photograph by E. S. Shaw, U. S. Forest Service

THE process of land deterioration known as erosion is the nightmare of farm management in thousands of sloping sections throughout the humid parts of the country. It reduces yields and profits more than any other soil problem with which the farmer of the rolling regions has to deal. Countless fields dissected with gullies or skimmed of fertile top soil deform the landscape in many localities. We have devoted our efforts largely to preservation of the plant food in soils, but have failed in many instances to preserve the soil itself.

The evil process of erosion has not stopped with stealing merely the plant food. It has taken the whole soil, the humus, the plant food and everything else, and this from the top layer, the very cream of the fields. The amount of plant food removed in crops taken off the land is small compared to that removed by erosion; at least 20 times smaller, according to the most reliable estimates we have. Soil erosion costs the farmers of the United States more than 200,000,000 dollars every year. Destruction and deterioration from this cause occur in every state of the Union, and in almost every county of every state.

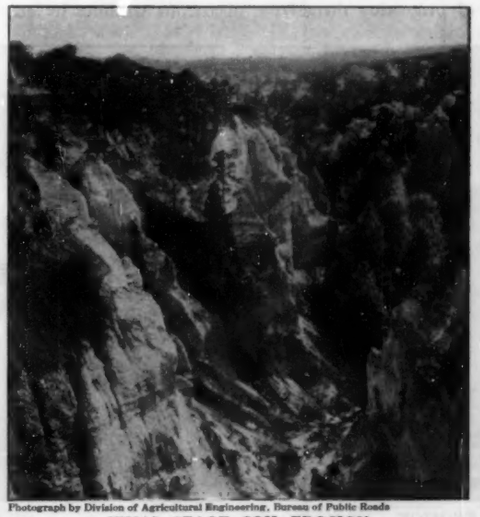
Erosion Not a Necessary Evil

The process of soil erosion works like compound interest, each rain taking additional toll of fields already impoverished. Every parcel of sloping land is affected. Continued shallow cultivation accentuates the stripping off of the good soil and the desecration of the landscape with gullies and abandoned fields covered with ugly weeds and bushes.

Plant explorers have scoured the face of the earth in search of soil-improving legumes; volume after volume and scores of bulletins have been written about "soil mining" by continued removal of plant nutrients in the crops taken off; and doctors of agriculture have lectured about the subject unceasingly. All this emphasis on the one process of land impoverishment, with seldom so much as a wee small voice raised against the other process, soil erosion, has effectively pushed the latter into the shadowy background, as if it were a minor affair, a necessary evil.

The writer has had some trying experiences with erosion on his farms down in the middle Piedmont section (a section which includes Virginia, North Carolina, et cetera), a country of rolling land where the chief concern is not so much with maintenance of fertility as it is with making the soil "stay put" on sloping areas. Devastation by rain-wash has taken reckless liberty with every sloping acre of ground—and there are few acres that are not sloping. This washing away of the soil forced a reorganization of the fields on these farms in order that the rows could be run *with* the slope contours rather than across them; that terraces could be effectively distributed through the fields; and that certain areas, not meant, by the scheme of creation employed in that locality, to be farmed, could be carved out and turned over to pecan groves, pastures and woodlots.

Some parts of these farms were in timber at the time they came into the possession of the present owner. Their history is interesting in that what has happened to them has happened to countless farms situated on soil of high susceptibility to erosion, wherever rain water was permitted to flow without restraint across cultivated slopes. These tracts were so gullied by washing that they were turned out of cultivation 75 years ago, and they can still boast of ravines capable of engulfing entire buildings.



Photograph by Division of Agricultural Engineering, Bureau of Public Roads

FINAL STAGE, SOIL EROSION

Looking over several hundred acres which show the destructive effects of long-continued soil erosion

The reorganization of these Piedmont farms included the elimination from tilled fields of all areas of this vulnerable type, wherever the slope was steep enough to cause the plant beds to be cut through by water rills during heavy rains. There was no difficulty about ascertaining where to draw the line. A glance about the fields after a sizable downpour was sufficient to show where the waste was greatest.

Land of this type should never be plowed on slopes that are more than moderately steep. Such soil is adapted to timber and to nothing else. Fortunately, pine trees thrive on it, growing in the bottoms of gullies and everywhere except on exposures of rock and raw clay. One heavy crop of timber has already been taken from these gullied areas, another is ready to cut, and a good young growth will soon follow to the sawmill. These farms are now being operated profitably, and the income from the timber adds to the surplus. The illustration at the top of this page shows such growth. However, should the terraces be neglected, more than half of the fields would go to utter ruin.

Sheet Erosion the Real Cancer

Geologists have estimated the amount of soil annually carried into the sea at more than one billion tons. This calculation does not take into account the soil washed from sloping areas and deposited upon lower positions and over the flood plains of streams where it is not needed. A minimum estimate of the plant food washed out of fields annually is 126 billion pounds; the net loss by crop removal has been calculated as amounting to approximately six billion pounds. A single county in the southern Piedmont section was found by actual survey to include more than 90,000 acres of "rough gullied land," at one time farmed but now permanently ruined for crop production and seriously impaired for timber growth.

Not far from this locality another county of the coastal-plain region showed by survey a total of 60,000 acres similarly ruined. In the "brown loam" belt skirting the eastern edge of the Mississippi River alluvial plain, the same kind of land spoliation was found in a number of counties to the extent of 20 to 40 thousand acres each.

But this class of soil destruction does not represent the real hammer blows of erosion. It is the

LAST STAGE, COTTON PRODUCTION

The original productive top soil has been permitted to wash away by slow sheet erosion

less conspicuous and slower type of washing, known as sheet erosion, that constitutes the real cancer of the earth. Here is the big leak, the bung-hole through which drips away the fertility of thousands of farms; and with this fertility goes much of the farm profits.

Sheet erosion proceeds insidiously with its work, going about its task with such quietness and unobtrusiveness that many attribute the increasing leanness of their fields to a worn-out condition due to sapping of the soil fertility by crops. This notion often holds even after "clay galls" and patches of outcropping rock take the place of former good soil. The process goes on in practically every sloping field of the humid region, and extends beyond into semi-arid areas. Every heavy rain covers the entire land surface with a flowing sheet of water. Thus the rivers actually extend from their beds to the very tops of the hills, and thus fleeing waters perform a most efficient job of planing off the top soil.

The Missouri Experiment Station, by catching at the foot of a hillside the material removed from fields undergoing a variety of cultural treatments, recently measured the waste soil wash on the Putnam silt loam, one of that state's important soil types. It was found that seven inches of top soil were being washed off every 24 years from land plowed four inches deep. From blue-grass sod, however, the rate of wear was seven inches in 3,547 years.

The scientists from Missouri, reporting on the results, had this to say by way of showing others what erosion means: "Most of the worn-out lands of the world are in their present condition because much of the surface has washed away, and not because they have worn out by cropping. Productive soils can be maintained through centuries of farming, if serious erosion is prevented. The soils of Missouri have become gradually less fertile during the last hundred years, due in a large measure to the excessive cultivation of rolling fields. Many of the most fertile soils in the rolling prairies and timber lands of this state have been kept in corn until the "clay spots" are evident on nearly every hillside. So much soil has been lost from even the more gently rolling parts of the fields that the yields are far below those obtained by our grandfathers who brought the land into cultivation. The erosion of cultivated fields is taking place at such a rate that it is calling for a decided change in our system of soil management."

And this statement leaves out of account the enormous loss of soil constituents by leaching, a process that might be termed internal soil erosion. But that is another story.

The Solution Lies in Terracing

The material washed from fields is carried into the valleys where it chokes stream channels and ditches, thus bringing about increasing overflows and immense damage to bottom land. From the overflow water, strips of loose sand and gravel, assorted by the currents, are deposited over fertile alluvial-silt loam and greatly reduce productivity. In some parts of the Ozarks region, gravel swept down from fields of steep, cherty slopes has literally buried valuable alluvial soil with comparatively inert material, and this often where the bottom land was the most valuable part, frequently the backbone of the farm.

Many towns in the lower Mississippi Valley, situated on former navigable streams, have not seen a boat for a generation, because the channels have been choked by deposits from eroding hillsides. In many instances the former channels have been obliterated or have split into a number of small channels incapable of carrying the increased floodwaters that came after, not before, widespread clearing of the timber from land of all topographic characteristics.

The extreme susceptibility of certain types to wash must be considered in any sensible plan for betterment of the erosion problem. There are many millions of acres of sloping land that should not be used for tilled crops under any circumstances, because of the impracticability, if not impossibility, of protecting them from disastrous washing by any other means except the growing of trees or grass.

WIRE-FENCE PROTECTION

The meshes quickly fill up and form a screen which effectively holds back the soil particles

Some of these lands are of very wide distribution. They include rolling lands, with stiff, impervious clay subsoil, such as the Susquehanna clay of the Gulf Coastal plain; steeply sloping areas of the red granitic soils of the Piedmont area with their "rotten rock" foundation; the "brown loam" soils of the loessial regions, with their soft substrata that melt away during rains like so much sugar; and types with other characteristics that favor rapid spoliation by rain-wash. Gullies must be stopped in their infancy on these soils, or they cannot be stopped at all. The best thing to do with such unstable land is to use it for trees and grass.

But let us not forget the story of the blue-grass plot at the Missouri Station and how it held back the soil 147 times longer than the same soil remained upon unprotected slopes. We cannot plant every hillside and sloping field to blue-grass, to be sure, but there are other means of checking soil-wash. We have heard about terracing slopes to save them from erosion. The great majority of farmers must believe this method is either a myth or unsuited to their local conditions, because when you leave the southeastern states, terraces are rare.

It has taken more than 50 years for this method of conserving soil fertility to extend out to central Texas. Recently some of the "black land" farmers of that section, finding that their rich prairie clay is not proof against washing, have begun to practice the terracing methods of their Carolina and North Georgia forebears.

The saving that has been accomplished by this

LAND PERMANENTLY DESTROYED BY EROSION

This area (in the brown loam region) formerly was under cultivation. The fertile silt loam could have been saved by timely terracing

RICH PRAIRIE SOIL WASHED AWAY

Failure to attend to washing slopes in time has resulted in complete destruction of thousands of acres of these valuable prairie soils

Photograph by Division of Agricultural Engineering, Bureau of Public Roads

THIS TERRACE STOPPED EROSION

The above is an artificial terrace. Before it was built, this productive field was a wasted area of unproductive, erosion-seared land

Photograph by Division of Agricultural Engineering, Bureau of Public Roads

GULLEY THREATENS FERTILE FIELD

Neglect has permitted this gulley to form in a rich Iowa field. Sheet erosion is washing away the top soil. Terracing would stop this wastage

system in the Piedmont section alone is incalculable. There are terraced fields in that hill country which have been continuously in crops for much more than half a century, and they are still producing satisfactorily. If the method has worked in that region where so much soil is extremely susceptible to washing, it will work in any other rolling section.

Those farmers who depend upon fertilizers to make up for deficiencies in yields due to washing off of the more fertile top soil are undertaking to fill a leaking bucket. It cannot be done indefinitely. Many thousands of fields already have passed the stage where fertilizers are satisfactory and have become definitely losing propositions, even in times of good prices for the crops produced. Field after field is abandoned to sassafras bush and cat-brier. The hapless farmer reaches the stage of feeling that he has "lost the touch" and moves to town or to another tract of land. This means he has been defeated in open battle against a foe who grants no truces and who never surrenders. There is no such thing as vanquishing the enemy, but his depredations can be effectively restricted to minor engagements by using timber land for timber, grazing land for grazing, and terracing the sloping fields.

There is immediate need of demonstration terraces in regions where this method of soil conservation has not been tried, as well as demonstrations in the reorganization of farm fields to better combat wasteful erosion. They are needed in the rolling parts of Ohio, Missouri, Iowa, Kansas and other Central States, as well as in the Southern and Middle Atlantic States.

The old saw about the more northerly lands being frozen in winter and thus safe from erosion during enough of the year to make the problem one of negligible importance should be passed on to the scrap heap. And with it should go the equally fallacious notion about terraces not being suited to northern conditions. Terraces will help save cultivated slopes wherever it rains enough for water to flow downhill, provided the soil is deep enough to plow up into a good formidable bed, and the slope not so steep but that the embankment will hold when properly adjusted to the contour.

In general, steep land that has less than 15 inches of soil over bed-rock is too shallow to save by terracing, and should go to timber or grass or orchards. Most of the thin slopes of the shale hills of the Appalachian region can not be efficiently protected except by keeping them in grass or turning them into orchards and woodlots.

Ugly patches of washed ground often can be utilized in ways that never would be thought of until a farmer wakes up to the expensiveness and uselessness of unrestrained erosion. Here and there one will see where clay galls have been obliterated by planting them with blackberries, dewberries, black walnuts, pecans and even apple and pear trees. Special treatment, often of an inventive nature, is required in the reclamation of these infertile areas, each of which may call for a particular kind of simple engineering. Ways and means will be worked out generally, once the idea has its birth.

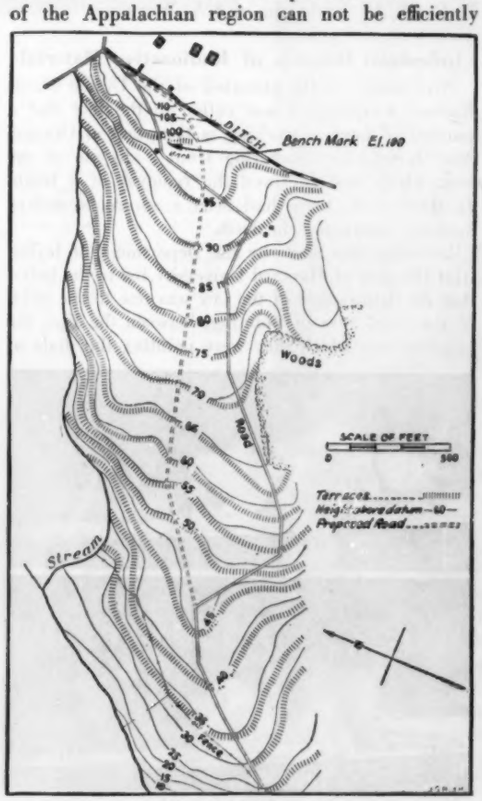
Some have made catchment basins by throwing up dirt embankments or building stone walls to intercept soil material washing from adjacent slopes. The accumulation goes on much faster than would be supposed, and there is always satisfaction in seeing good soil grow where only raw clay existed before. Others have dug holes and filled them with productive soil hauled from odd corners of the farm, from woodlot or branch bottom, before planting. Many other methods have been successfully employed.

Our national and state foresters are doing splendid work in the field of soil conservation. Reforestation and forest protection are mighty implements of soil defense, and the efforts of those engaged in these worthy endeavors should be assiduously encouraged by every friend of field and woodland.

Photograph by Division of Agricultural Engineering, Bureau of Public Roads

EARLY STAGE OF EROSION

This shows a sloping eroded area of Susquehanna clay in coastal plain region of Georgia



HOW TERRACING IS DONE

The terraces intercept and carry away the rain water laterally before it gathers erosive volume and force

Photograph by Division of Agricultural Engineering, Bureau of Public Roads

INTERMEDIATE STAGE OF DESTRUCTION

View taken in coastal plain region shows soil before it is completely washed away down to rock

The Month in Medical Science

A Review and Commentary on Progress in the Medical and Surgical Field

By Morris Fishbein, M.D.

Editor of the *Journal of the American Medical Association* and of *Hygeia*

Sunlight and Tuberculosis in Children

SINCE Rollier of Switzerland published his important work in 1915, showing the value of sunlight in the treatment of tuberculosis, particularly of the bones and joints, the value of this method has been confirmed by numerous investigators. Dr. R. K. Ghormley has made available the results of 63 cases of tuberculosis of the spine studied in the New England Peabody Home for Crippled Children in Newton Center, Massachusetts. In that place not only was outdoor sunlight used, but also artificial light of the mercury vapor quartz type was substituted for sunlight on cloudy or cold days. He finds that the artificial light has definite tonic effects in some cases, and also that

HOLDING THE BONES IN PLACE

This specially constructed jacket is used as an adjunct to spinal treatment by means of ultra-violet rays

calcification both in the spine and in the abscess that is not drained is hastened by the sunlight treatment.

In addition to that, such patients are given proper diet, fresh air, rest, and mechanical treatment by apparatus especially prepared for the purpose.

A machine called the Young tracing machine is used to keep an accurate record of the deformity. It is something like the one used to measure head conformation of men who wear derby hats. A weight chart is kept as well.

In addition, the children are treated with special jackets, which hold the bones in place when they walk about, and are placed upon frames for modeling the formation of the spine when they are kept recumbent. The child is then permitted to run about until the deformity shows improvement and the muscles are sufficiently strong to hold the bones in place. Following these methods of treatment, there is considerable improvement in these cases. Indeed, far more than was the case before modern medicine applied the various agencies that it uses in treating these unfortunate children.

Synthalin for Diabetes

SINCE the discovery of insulin, scientific physicians everywhere have sought for some synthetic substance which would replace this glandular extract and which could possibly accomplish similar effects in the reduction of sugar, even when taken by mouth. In 1889, two German investigators, von Mering and Minkowski found that the complete removal of the gland called the pancreas would result in the appearance of severe diabetes. Insulin is made from this gland. Now three workers in Minkowski's clinic have prepared a substance, synthalin, which when taken by mouth will reduce the sugar content of the blood of either normal or diabetic animals or persons. It can be absorbed unchanged from the stomach and produces its effects more slowly. The substance is a combination of a guanidine compound named agmatine. It is not entirely devoid of poisonous effects, because an overdosage is accompanied by loss of appetite, irritation of the stomach and intestines, together with nausea and vomiting.

It has been found that in cases of moderate severity, a patient taking this substance can use 40 or 50 grams more sugar than he could without the substance or without insulin. It therefore is possible to use this substance in the place of insulin in milder cases of diabetes.

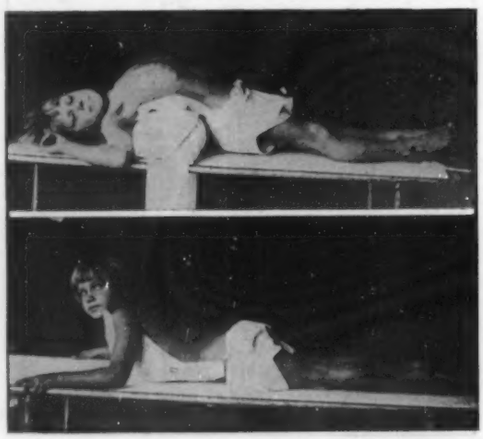
The chemical nature of insulin is unknown. It is certain that the present substance is not insulin, but it is a question as to its exact relation to that product.

The investigators credited with the work are Drs. E. Frank, M. Nothmann and A. Wagner.

Industrial Hazards of Radioactive Material

NOT long ago the attention of the United States Radium Corporation was called to the fact that a number of persons working in the plant at Orange, New Jersey, were suffering from a disease of the jaw, which had followed the removal of a tooth. In these cases there had been a severe secondary anemia, terminating in death.

Investigations made by the Department of Industrial Diseases of Harvard University led to the belief that the disturbance of the jaw was due to the habit of the employees of pointing, between the lips, the brushes with which they were painting the dials of



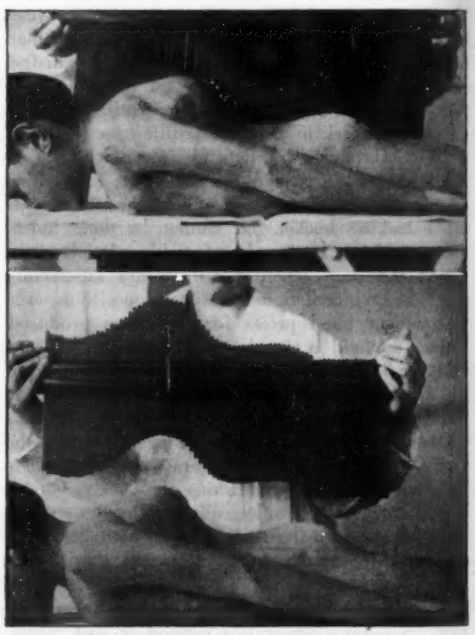
FOR RECUMBENT POSITIONS

These photographs show how the jacket is used when patient is recumbent and when receiving sun treatment

watches and clocks. In this way small amounts of radioactive material were taken into the mouth, and it was believed that this material had caused the disturbance of the jaw.

An investigation was made also by Dr. Frederick B. Flinn, who conducted numerous experiments with luminous paint to determine the exact extent of this hazard. The gums of a number of guinea pigs and goats were coated with the paint for a period of six months. During this time no irritation of the gums or mouth was detected in any of the experimental animals, and examination with the X ray failed to reveal any disturbance of the bones.

Complete physical examinations were made of all of the employees working at dial painting, but not one other case of jaw necrosis was found among



RECORDING SPINAL IMPROVEMENT

In the Young tracing machine, a set screw at the end holds the markers in place until the tracing is transferred

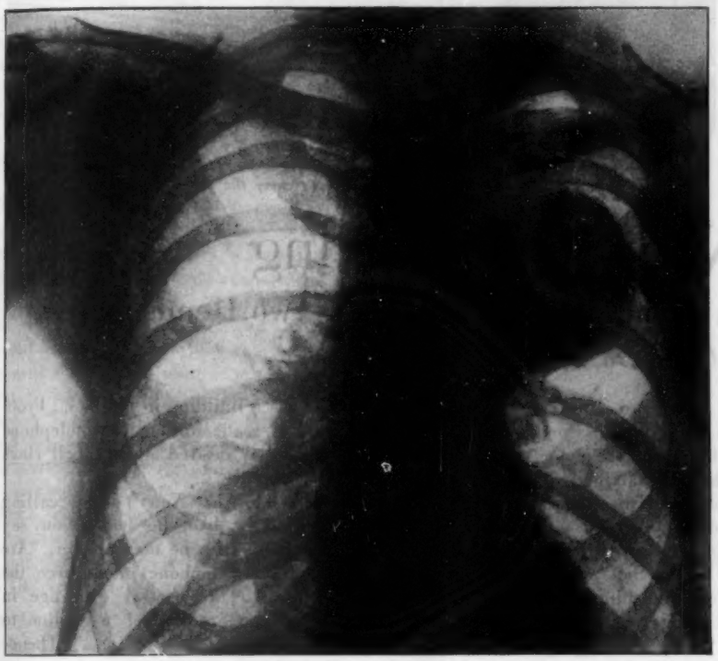
them. As a result of these investigations, it is now reported that there is no industrial hazard in the painting of luminous dials. The present investigators are therefore inclined to doubt that the five employees who died with the disturbance of the jaw that has been mentioned developed that disturbance as a result of their occupation. Since there are numerous infections of the jaw of varying severity, the diagnosis in the early cases must be considered as not established.

The Weather and Sudden Death

THE number of deaths from organic diseases of the heart, brain hemorrhage and chronic inflammation of the kidneys has been found, by Dr. Herman Bundesen, health commissioner of Chicago, and some of his assistants, to be unusually high when the temperature is low, and low when the temperature is high. They did not find any definite relationship between the amount of disease, the number of deaths and variations in the barometric pressure, although a British physician who investigated the subject noted that there were more sudden deaths when the

barometric pressure was high. It has been rather generally well known that the number of deaths from causes associated with circulation of the blood is higher in cold weather than in warm weather.

Drs. L. H. Roddis and G. W. Cooper, surgeons in the Medical Corps of the United States Navy, find that the blood pressure is definitely modified by climate. In the tropics the blood pressure of white men averages from 10 to 15 millimeters of mercury below the normal for the temperate zone. Under tropical conditions, the routine of life includes a smaller amount of physical work, the adoption of the siesta, and special precautions as to food and clothing. It is possible that these changes in habit may be associated with a change in the blood pressure; if so, they are an indication, to those with high blood pressure, as to a manner of living that will be of help.



DILATED BLOOD VESSEL

The X-ray photograph at the left shows a dilated blood-vessel, the condition being called aneurysm, and frequently resulting in death. The cause is a weak spot in the wall of the vessel, which gradually expands due to the constant surging of the blood against it. This condition is attended by severe pains and other symptoms of the disease. Coagulating the blood at the weak point is often found to be helpful

Electrolysis with Wiring in Aneurysm

AN aneurysm is a dilated point in a blood vessel. It occurs usually due to the fact that there is a weak spot and that the beating of the blood against the spot causes a dilatation. Usually the condition proceeds to the point where the wall of the blood vessel becomes so greatly weakened that it bursts and the patient dies. Long before death, however, such persons suffer severely with pain and other symptoms of this disease.

It occurred to one investigator to stop the passage of blood into such a sac by inserting a coil of wire which would cause the blood to coagulate in the sac without coagulating the blood passing through the vessel. Later arrangements were made for passing electric current through the wire, which still further hastens the coagulation process.

Dr. H. A. Hare of Philadelphia has described numerous instances in which this procedure was tried. In the case shown in the illustration, fifteen feet of wire made of platinum, 30 percent, and gold, 70 percent, was inserted at the point of pulsation through an insulated needle and five milliamperes of electricity turned on. The milliamperage was gradually increased until a total of 45 was reached, after which the current was maintained for ten minutes and then gradually cut down. Following the use of this method, the pain is ameliorated and the clotting of the blood stops at least temporarily the development of the aneurysm.

AN ELECTRICAL AID

In the alleviation of aneurysm, it has been found helpful to coagulate the blood in the sac formed by the expanding blood vessel, without stopping the passage of the rest of the blood. One method that has been used is to insert a coil of wire and pass a small current of electricity through it. The X-ray photograph at the right shows such a coil of gold and platinum wire in place and ready for use

The Bacterium of Rheumatic Fever

ON the basis of some brief investigations made in the Philadelphia General Hospital, Dr. James Craig Small reported the isolation of a streptococcus, a round bacterium occurring in chains, to which he gave the special name streptococcus cardioarthritidis, and which he claimed was the specific cause of rheumatic fever. On the basis of his claim, he prepared a serum by making injections into a horse, and treated patients with this serum.

Dr. Small himself admitted that careful experiments on the treatment of patients with the serum alone and without the specific serum were necessary before it could be said the organism was specific, or the method of treatment of special virtue. In the meantime, the evidence already available concerning the use of nonspecific protein injections in the treatment of rheumatic condition causes the majority of physicians to hesitate in accepting the claims that have been made.

Right-handedness and Left-handedness

DR. RIESE of Frankfort-on-the-Main has made a special study of the brain in left-handed persons. These studies serve to disprove absolutely a number of superstitions relative to left-handedness. He showed, first of all, that left-handedness is not a mark of mental inferiority; second, that the right-hand side of the brain develops when the person is left-handed in the same way that the left-hand side of the normal brain develops when the person is right-handed.

In the case of a left-handed painter named Menzel, the right hemisphere of the brain was found to have more convolutions, to be more folded and more tortuous. There was an increase in the amount of the tissue substance, and other manifestations to indicate anatomic expressions of special efficiency of the left hand in the man concerned.

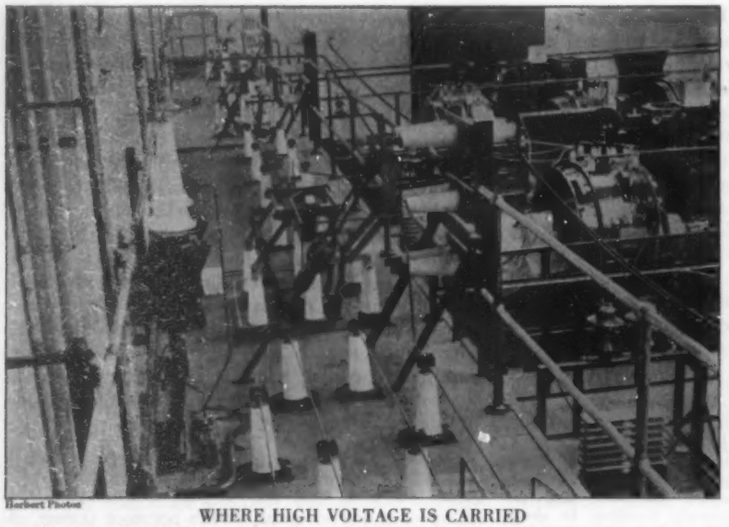
The Failure of Operations for Rejuvenation

LIEUTENANT J. P. ARLAND of the Royal Air Force Combined Hospital in Busrah, India, has just made available the report of fifteen cases of attempts to produce rejuvenation by the Steinach operation of tying off the ducts and by the Voronoff method of transplanting the organs of monkeys. In the two cases in which organs were transplanted there were severe reactions. In only one of the fifteen cases was there anything remotely resembling benefit to the patient. The author concludes that the methods are discouraging and of doubtful value.

Epilepsy

IT has long been known that an injury to the brain of a dog or a cat, or the presence therein of a foreign substance such as a bullet, in the region of the motor cortex would cause spontaneous convulsions from time to time. This is taken to indicate that injury in this region of the brain lowers the threshhold of stimulation for convulsions. Dr. Walter E. Dandy and his colleagues in the Johns Hopkins University and Hospital have completed a series of investigations to find out some of the reasons why convulsions occur in epilepsy. They conclude that the motor cortex of the brain alone is responsible for the type of convulsions known as clonic, and that this portion of the brain must therefore inevitably be associated to a considerable extent in the convulsions of epilepsy.

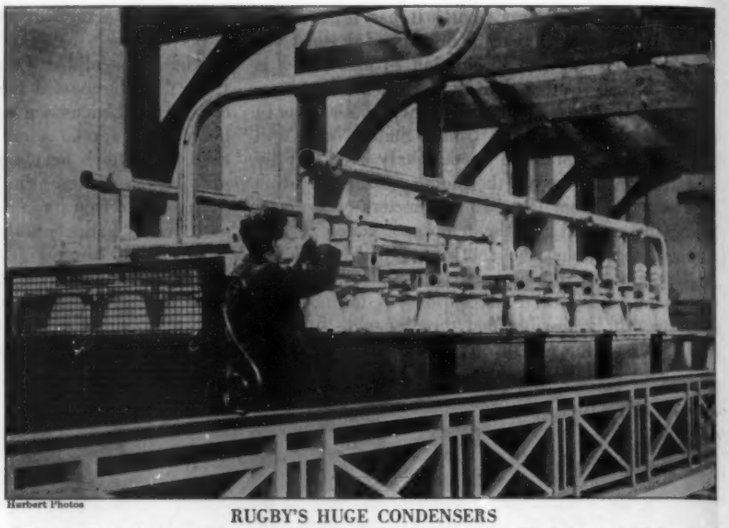
It is known that the epileptic has a preliminary stage just before the convulsions that is called an aura. The Baltimore investigators believe that the nature of this aura indicates the portion of the brain in which the convulsions tend to arise. For example, if the aura has to do with taste or smell, the lesions are in the uncinate lobe of the brain which has to do with these functions; if the aura is one of sight, the stimulation to the convulsions arises in the visual center, and so on. Stimulus of sufficient strength in any part of the hemisphere of the brain will bring the motor cortex into action and convulsions follow.



Herbert Photos

WHERE HIGH VOLTAGE IS CARRIED

The high-tension insulating gallery and conducting bars at the Rugby transmitter. Note the huge switches mounted on large porcelain posts to insure ample protection



Herbert Photos

RUGBY'S HUGE CONDENSERS

This is said to be largest instrument of its type in the world. The heavy metal bars and pipes are the connections which serve to carry the powerful surges

"Hello, London—New York Calling"

"... Marks the Beginning of a New Epoch in Communication Between Two Hemispheres"

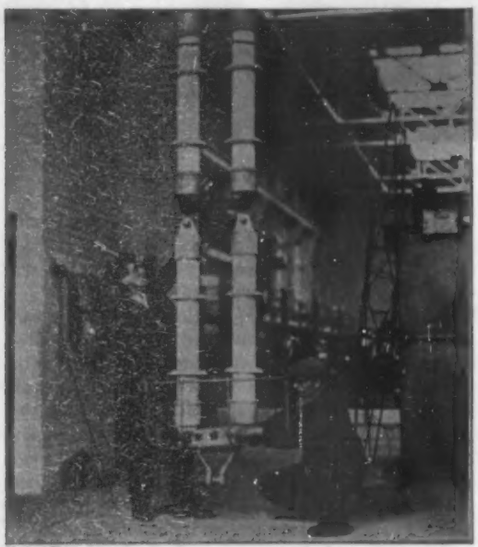
By Orrin E. Dunlap, Jr.

"HELLO, London. New York is calling." These few words wafted across the sea on January 7, 1927, over an invisible "talk-bridge," officially opened a telephonic service between the Old and the New Worlds, and the public mind was captivated by another radio achievement.

When the international circuit was closed after its first day of operation, scores had chatted back and forth across the ocean with no more effort than is necessary in talking from a coin box on Broadway to an apartment on Manhattan Island. Wall Street houses talked with London regarding foreign exchange quotations and more than 6,000,000 dollars worth of transactions were effected through the air without confusion or delay. It was a big day for radio and the new system was heralded by the press as "the most remarkable communication service yet devised by man."

Shortly after the official opening, at 8:30 o'clock that same morning, Walter S. Gifford, President of the American Telephone and Telegraph Company, lifted the receiver from his desk telephone and within a minute or two, he was talking with Sir G. Evelyn P. Murray, Secretary of the British Post Office, over a circuit made up of 6,300 miles of ether and 850 miles of telephone line. Then private conversations began to flow across the "talk-bridge" at a cost of 75 dollars for three minutes and 25 dollars for each additional minute.

Now the "gates" of the "bridge" are opened for traffic each morning at 8:30 o'clock and close at 1:30 P.M., Eastern Standard Time. Thus the first half of the business day is finished in England when the service opens, and it is half gone in the metropolis of the New World when the service closes. This limitation of the service is not only imposed by the differences in time, but transmission becomes less reliable when it is dark on one side of the sea and daylight on the other. When the sunrise and sunset walls creep out across the Atlantic from the European shores they act as huge international curtains, which cause radio waves to fade, swing and weaken.



Herbert Photos

GIANT AERIAL INSULATORS

These non-conductors of electricity are ten feet high. They serve to prevent leakage from aerial to ground

One-way "Doors" Made It Possible

Suppose you are in New York and you wish to talk with a friend in London. You may be interested to know what happens from the time you lift the receiver from the hook until the person in London hears his telephone bell ring to announce that you are on the air and on the line.

You ask for "long distance," just as you would if calling Chicago or San Francisco, and the toll operator connects you with the western terminal of the transatlantic circuit located in the long-distance headquarters of the American Telephone and Telegraph Company at 24 Walker Street, New York City. From that point the voice is relayed over 70 miles of telephone wire to Rocky Point, Long Island, the western gateway to the invisible "bridge." A powerful vacuum-tube transmitter gives the words impetus sufficient to hurl them across the 3,000 miles of water to Wroughton, England, where a receiving antenna plucks the voice from the air and forwards the electrical impulses over 90 miles of land wire to the British Post Office Building in London. From there a connection is made to the local telephone central office of the party desired and the bell rings to call him to the 'phone.

The operator tells him that New York is calling and within a minute or two, he hears you say "Hello," and if he is English he may answer, "Are you there?" From his telephone mouthpiece the words are sent through the central exchange in London and then over 85 miles of wire line to Rugby, the eastern terminal of the "bridge." Thence his words are flashed across 2,900 miles of space to Houlton, Maine, from which point 600 miles of telephone wire carry the words to New York City and into your telephone receiver. You and your friend are then enjoying the use of an extensive installation costing more than 5,000,000 dollars and a system which represents years of research and the latest in radio developments.

Sensitive electric relays or one-way "doors," as

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ONE OF THE BIG TUBES

The 15-inch tube, compared here with a standard receiving tube, is water cooled to prevent over-heating

they are called, play an important part in the circuit. When a New Yorker's voice leaves for Rocky Point, one relay is opened by the voice wave and another relay at Houlton, Maine, is automatically closed to prevent the words broadcast from Long Island being picked up and creating a short-circuiting effect, which means that, without these relays, the New Yorker would hear his own words come back. In other words, he would be talking to himself. As the system is devised, when the New Yorker stops speaking, even if just to take a breath, or give the man at the other end a chance to answer, the two electrical "doors" function in reverse fashion so that the words from London reach the New Yorker, and the relay at Rocky Point prevents the voice of the Englishman from being rebroadcast at the American end. Similar one-way "doors," at the London terminal quickly switch from the incoming to the outgoing speech wave, opening and closing with such speed and facility that the conversation is uninterrupted and the speakers are unaware that these "doors" are swinging to and fro in the circuit.

Four important developments in radio and telephonic work, which made the "talk-bridge" possible are: the single side-band method of transmission; the high-power, vacuum-tube transmitters; the piezo crystal and the telephone repeater or amplifier.

When the ordinary broadcasting station goes on the air, a carrier wave and two side bands are projected through space from the aerial wires. Sixty percent of the total electric power radiated is in the carrier wave, but it does not convey the music or voice. The side bands carry the concert. Thus, the engineers, in developing the transoceanic circuit, eliminated the carrier and one side band, thereby conserving electrical energy and also space in the ether. They actually whittled the original wave to a narrow strip.

But they discovered that the amputated wave was of little use at the receiver unless the carrier and

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A RADIO GATEWAY

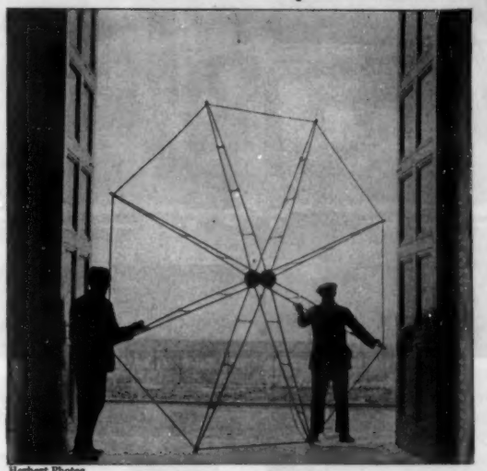
Notice the height of the insulators used on the lead-in at Rugby, as compared with the men in this photograph

other side band were grafted back on the parent wave at the receiving station. So they used what is called a heterodyne oscillator, an instrument which combines the incoming signal with a locally generated alternating current, forming a receiving process called "beat reception." The frequency supplied by this oscillator interacts with the incoming side band and reproduces the original audio frequencies spoken on the other side of the sea.

However, if the wave in crossing the ocean strayed even slightly from its exact channel it would be difficult to tune in when it reached New York. Therefore, the engineers utilized a piezo crystal, or tiny crystal wafer, which, when placed in the transmitting circuit, has the property of holding the station on its exact wavelength. Thus, it cannot stray or wander in the ether. Quartz is generally used as the crystal because it is not affected greatly by temperature.

When Paris listened in to voices broadcast from Arlington, Virginia, in 1915, a unit of 500 vacuum tubes was used to set the ether in vibration. Today, water-cooled tubes are employed which are many times more powerful than the tubes used 12 years ago. In fact the "talk-bridge" uses about 100 times more power than the apparatus of 1915.

The telephone repeater is likened unto the runner in a relay race, because its duty is to pick up the voice frequencies, give them renewed strength and send them along the wire to the next repeater station. One of the reasons why the problem of long-distance radio telephony was laid on the shelf in 1914 was to wait for the development of a reliable



Herbert Photos

AN AERIAL SPREADER

The cage-type aerial at Rugby is held in shape by means of 12-foot spreaders such as the one shown

repeater. Today, a repeater is an insulated box containing seemingly numberless wires and coils. No manual operation is necessary. A repeater attendant spends his time watching to see that the two vacuum tubes remain lighted. Three of these repeaters are used along the line which brings the British voices down from Houlton, Maine, to Manhattan Island.

The initial field trial which led to the present transatlantic telephone circuit was arranged in 1915 with Montauk Point, on the eastern tip of Long Island, as the transmitting site. The top of an office building in Wilmington, Delaware, was selected as the receiving station, because an antenna had already been erected there. Voices broadcast from Montauk were picked up in Wilmington, 300 miles away. A telephone line was connected to the receiver, so that the engineers at the transmitting station could hear their voices come back. Further-

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AT THE ENGLISH END

These lofty masts located at Rugby support the transmitting aerial wires 820 feet from the ground

more, a speaker in Wilmington could talk into the telephone and hear his voice return by radio. This 500-mile circuit demonstrated not only that radio telephony was practical but that wire and radio could be operated in conjunction.

This was considered a good start but the final goal was Europe! Scouts were sent further down the Atlantic seaboard in quest of a new receiving site and their search resulted in the selection of St. Simon's Island, Georgia, 800 miles from Montauk Point. After listening for several weeks to determine the best hours for reception, success was attained but the voice was much weaker than it was at Wilmington. However, the received voice was again put on a telephone line and sent to listeners in New York City.

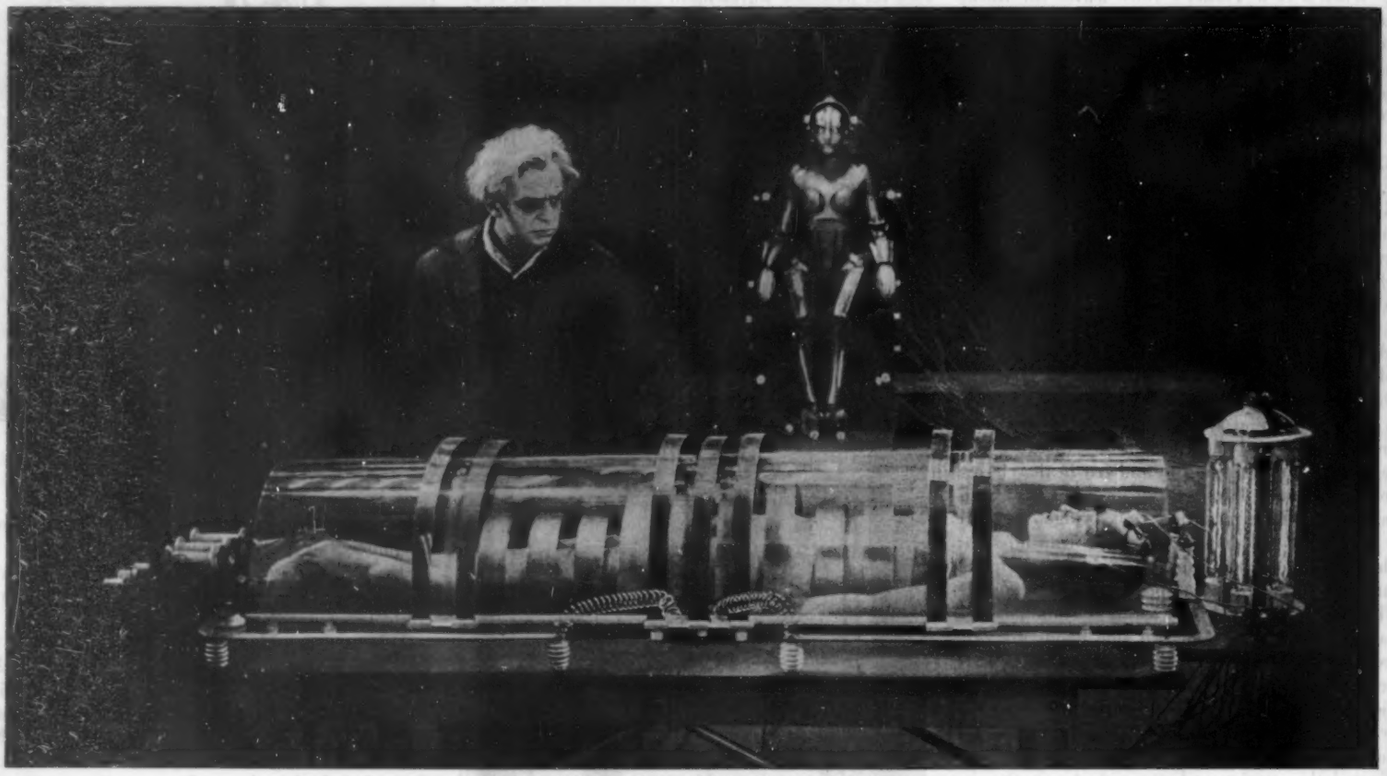
These tests proved that if a more powerful transmitter could be designed, greater distances could be covered and possibly the Atlantic Ocean could be spanned with the human voice spoken into an ordinary telephone transmitter.

Engineers directed their attention to the development of a more powerful transmitting tube. Before long a tube with a rating of 25 watts emerged from the laboratory. The next step was to install a complete radiophone transmitter at Arlington, Virginia, using 500 of the 25-watt tubes, which were capable of radiating about one and one-half kilowatts of useful power. Listeners in Panama first reported reception of the voice; then San Francisco heard it; then Honolulu, 5,000 miles distant, and finally in October, 1915, auditors at the Eiffel Tower in Paris cabled that they had caught the words, "and now, Shreeve, good night." On the evenings that followed, reception in Paris was much better, and clear enough to convince the engineers that, with the development of still more powerful vacuum tubes, the "talk-bridge" would be a reality.

Herbert Photos

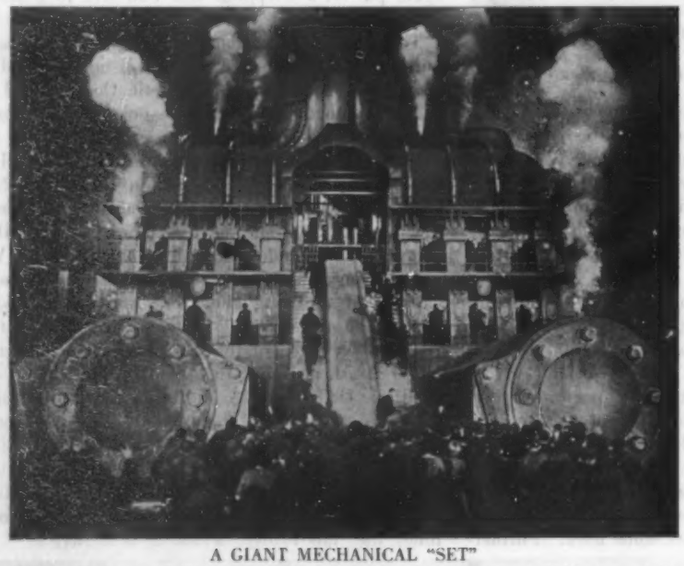
CONTROL PANEL AT RUGBY

In order to be sure that everything in the transatlantic radio-telephone system is functioning properly, numerous operators are necessary. The two men in the photograph at the right are watching closely various meters and dials which will indicate trouble as soon as it arises. It is only by such foresighted preparations as these that long-distance radio telephony can be made commercially practical. Because of the extensive equipment necessary, the toll charges are, as yet, high



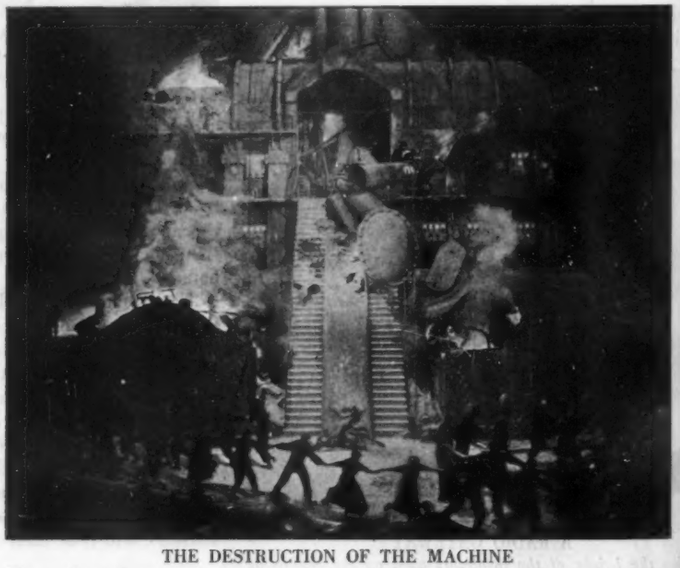
THE CREATION OF THE ARTIFICIAL WOMAN

The human being who is to serve as the model for the mechanical monster is placed, bound and helpless, in a glass case. Various queer appliances are connected to the case and to her body, being in turn connected to the figure of the artificial person. The fantastic result is a merciless "manufactured" woman



A GIANT MECHANICAL "SET"

This realistic reproduction of a power machine of the future is probably one of the most ambitious arrangements ever constructed for the taking of motion pictures



THE DESTRUCTION OF THE MACHINE

The mechanical woman finally runs amuck and completely destroys the machines that furnish the power to Metropolis. Toward the end of the story, she also is destroyed

"Metropolis"—A 'Movie' Forecast of the Future

Occasionally a motion picture of unusual merit comes to us from Germany. The latest is one which gives a glimpse of the way in which one motion-picture director has visualized the future of our civilization. The story of this newest UFA production, "Metropolis," deals with a city run entirely by machinery and divided into three distinct strata. In the upper of these dwell the rich class who are free and have no labor to perform. In the center section are located the great machines which serve the needs of the entire community. The working class live in the lower level, remote from sunlight and fresh air. Their labors are confined to the upkeep of the great machines in the middle stratum. These people are compelled to do only this work and have no pleasures. Their homes are in numbered cubicles and they are devoid even of names. The overlord of all of this, named Masterman, is the incarnation of ultra efficiency and cruelty. One of his ambitions is to produce a machine which will look and function as a human being, yet will be efficient to the last degree and will not have any of the short-comings of the human race. To this end, he employs the services of an old mad inventor, who is kept at hand for just such work. Here is where romance enters the picture. Masterman's son is in love with a girl of the lower world. The inventor seizes this beautiful creature and carries her off to his laboratory. Here he binds her and places her

FILMING A FLOOD SCENE

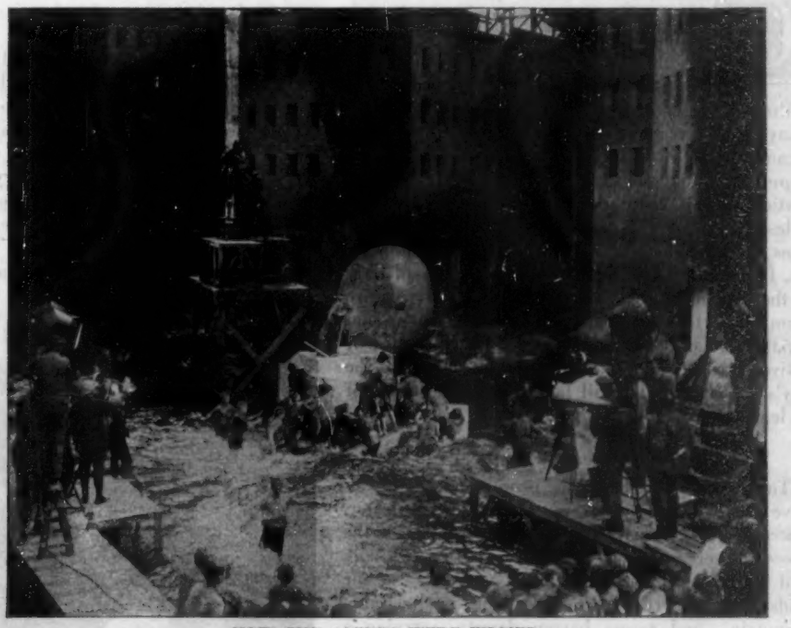
Many of the parts of this new motion picture were taken in specially devised tanks, so that realistic flood scenes could be obtained. In the one illustrated, a woman is carrying a child through the water. The reason for the great flood in the picture is that, when the mechanical woman destroys the machinery of the city, the giant pumps that keep the lower sections free from water are broken. Therefore, the waters rush in and, but for a timely happening, they would have overwhelmed the populace in the workers' quarters and drowned them like rats in traps

ON COMES THE FLOOD

In this "still" are shown only those parts of the action that the motion-picture audiences will see. The waters pouring in from all sides are directed from hoses and tanks so as to obtain the best possible photographic effects. The camera-men and the directorial staff are located on platforms at various strategic points so that no part of the continuous action will be missed or will be out of the camera lines

THE SAVIOR OF THE WORKERS

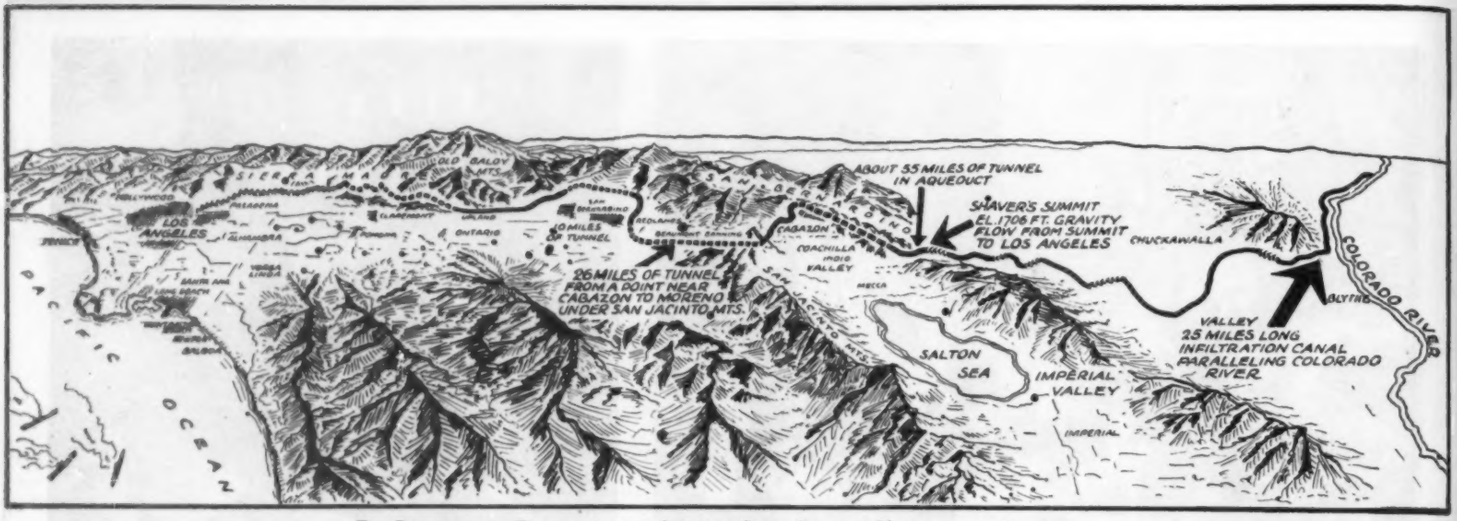
The woman who served as the model for the mechanical monster is shown here sounding an alarm and rescuing the people of the lower city



HOW THE SCENES WERE FILMED

This shows the arrangement of the studio when the scene illustrated at the left was being taken. Note the numerous cameras, directors' locations and spot-lights that were used

in a specially constructed chamber. She is to serve as a model for his fiendishly conceived super-machine that will fulfill all of the requirements of Masterman. When the dreadful process of producing a mechanism fashioned after the form and actions of a human being, but devoid of a soul, is completed, the inventor finds that he has created a second Frankenstein monster. The mechanical woman starts on a career that only ends when she has succeeded in demolishing the giant machines in the middle stratum, and is destroyed herself. With this comes the emancipation of the workers in the lower level and their restoration to the rights of citizenship. Need we say more of the happy ending of the picture? It is said that the director, Fritz Lang, spent two years in the preparation for the filming of this fantastic glimpse of the future. He studied the subject from all angles and consulted with prominent German industrialists and scientists. Some of the results are pictured in the above photographs. The gigantic machinery of the middle section was built in full size. The flood scenes were taken in a huge tank and arrangements were made so that the players were at all times under the immediate supervision of the director. One of the scenes in Masterman's office depicts some of the apparatus that this genius uses in accomplishing his work. A huge board presents constantly changing quotations of stocks all over the world. Loudspeakers constantly give orders, and an elaborate signal system permits intercommunication. All in all, the sets are weird and awe-inspiring in the extreme. Many of the photographic effects are unique and show an attention to detail that might well be copied by our great American motion-picture producers.


ABOUT 55 MILES OF TUNNEL IN AQUEDUCT
SHAVER'S SUMMIT EL. 1706 FT. GRAVITY FLOW FROM SUMMIT TO LOS ANGELES
26 MILES OF TUNNEL FROM A POINT NEAR CABAZON TO MORENO UNDER SAN JACINTO MTS.
10 MILES OF TUNNEL
LOS ANGELES
PACIFIC OCEAN
SALTON SEA
IMPERIAL VALLEY
COLORADO RIVER
CHUCKAWALLA
VALLEY
25 MILES LONG INFILTRATION CANAL PARALLELING COLORADO RIVER

THE ROUTE OF THE WATER FROM THE COLORADO RIVER OVER THE MOUNTAINS TO LOS ANGELES

Transporting a River Over Mountains

Tapped at a Point 260 Miles From Los Angeles, the Colorado River Is to Furnish Part of the Water Supply for That City

By Edgar Lloyd Hampton

ON the day this paragraph is being written, a dozen steam shovels are digging into the alluvial soil on the west bank of the Colorado River, 260 miles east of Los Angeles. They are making an infiltration reservoir, the significance of which is many times greater than its physical proportions, because of the things it represents. Los Angeles has begun the actual physical task of bringing a large portion of the Colorado River a distance of 260 miles, across deserts and over and under mountains, for the domestic use of its people. The project, from an engineering standpoint, is second only to the Panama Canal. Its completion will require from seven to nine years, its cost will be around 175,000,000 dollars, while the water which it will deliver through its snake-like conduits, added to the city's present supply, will take care of the needs of at least 10,000,000 people.

Looking Ahead Ten Years

This is not the first time the people of Los Angeles have been forced to go out in search of water. There is that unparalleled engineering feat, the Owens River aqueduct, which was started in 1908, and finished five years later. It was built in the midst of a wilderness, through all but impenetrable mountains, and across barren deserts—carrying a huge river from a 5,000-foot elevation over a distance of 256 miles to the city's gates, in an enterprise so huge and so difficult that engineers from all parts of the world came to study and observe its progress. It was built out of grim necessity—to meet the demands of a population that had increased beyond reasonable belief, and of industries that cried aloud for assistance. The result was a water supply sufficient for the needs of a 2,000,000 population, enough to last, it was thought at the time, for not less than half a century.

That was only 13 years ago. Today, with equal grimness of purpose, and likewise anxiety over obstacles and delays, the Colorado River aqueduct is being built, an undertaking four times larger than the Owens River system. Indeed, it is the largest domestic water project ever undertaken by any municipality. It is being built because the continued inrush of population and industries leaves no room for doubt that within the next ten years the Owens River aqueduct will prove entirely inadequate to carry the load which increases each year.

It was of course natural that so huge an undertaking should attract the general attention of engineers. And so it did. In fact it would seem that every engineer in the entire country has a plan for bringing the Colorado River to Los Angeles. One of these plans, by a government expert, starts 350 miles away, in the Grand Canyon, zig-zags through mountain passes, includes unbelievably long and intricate tunnels and, after some 550 miles of travel, reaches its destination over a perpetual gravity flow. Another one, known as the San Juan River project, starts 700 miles away, in Colorado. A third one, equally complex, is involved in a development plan put forward by Arizona. However, the faith of Southern California in the man who conceived and built the Owens River aqueduct is so great that the plan of his engineering corps, still subject, however, to minor alterations, is the one upon which construction work is now actually being based.

THE SITE OF BOULDER DAM

The Colorado River is shown at a low-water stage. During flood time, the water is often 200 feet deep

Before this construction task can move forward in full force, an extensive system of roads and trails must be built, similar to those required in the Owens River project. It will be necessary to provide a water system, a telephone system, and installations for electric light and power, to serve every part of the 260 miles. The work will move forward in many sections, calling for a dozen division headquarters, and at least 60 different construction camps, placed at some five-mile intervals along the route, to provide homes for the 5,000 men who will live and work in the radius of this aqueduct through a long series of years.

Fifty-five Miles of Tunnels

That no one can more than vaguely visualize the physical obstacles that confront the builders of this huge waterway must be clearly apparent. The water, as it comes from the river, will enter an infiltration reservoir which begins on the west bank and, paralleling the channel, extends southward for a distance of 20 miles. It is in this reservoir that the desilting process will take place.

The southern extremity of the reservoir is the intake of the aqueduct, which will be built of steel and reinforced concrete, while its diameter—18 feet—will be sufficient to carry the prescribed volume of water traveling at the rate of about five feet per second. Its general direction will be due west, some 260 miles, to the impounding reservoirs on the outskirts of Los Angeles.

Now a 260-mile journey across an open, level area, would of itself prove a considerable undertaking for an aqueduct. Yet no such easy journey

awaits the one now under consideration. There will be deserts to cross, and many mountains to scale. There will be chasms to negotiate, and cuts to make, with syphons and shafts and intervening reservoirs. All told there will be 55 miles of tunnels underneath the mountains. One of these will be 26 miles long. Or, it may be divided into two tunnels, of about equal length. They are still debating this point. In any event, since the building of tunnels will determine the length of time required to finish the task, that part of the work will begin at an early date.

On the question of reservoirs, the engineers have definite information. There must be constructed, at various points along the way, impounding reservoirs to take up the slack and absorb the variations of flow in case of accident—for example, if lightning should strike the power plants and put them out of commission. In such an event, the tremendous pressure of water, rushing down-grade between the various "lifts," would burst the huge pipes, shut off the supply, and cause incalculable damage. At least that is the notion gained from the engineers, who are meeting the situation with this string of emergency reservoirs.

Water Must Be Made to Climb Mountains

One of the chief problems involving the present situation is that when this aqueduct is completed, the water which passes through it can do so only by a pumping process. If water could only be made to run up hill! Since this cannot be done, it will be necessary to pump it over the mountain ranges. The Owens River aqueduct is a gravity type. In its 5,000-foot descent, the city, at the present time, develops 110,000 horsepower of electrical energy from the water. The Colorado aqueduct, however, must climb the mountains before it can descend them. Its intake is but 289 feet above sea-level. The highest point of its journey is 1,706 feet. This 1,417 feet of difference represents an expenditure of hydro-electric energy.

Not only are they forced to lift this water once, they must lift it several times. For the water, in leaving the river bed, begins at once to ascend the mountain ranges in a series of steps which continue for 75 miles. Along this stretch must be constructed five gigantic power plants, each one driving the water on toward a higher level. But, as the water passes each of those power plants, following a natural law, it starts once more down hill. So, with a proposed descent of 18 inches per mile, for a distance of 75 miles, it will drop an additional 112 feet, thus calling for extra energy to lift it up again.

This fact, prosaic enough in itself, presents an economic problem of huge proportions, not only for the engineers, but for those who must do the financing. If they should decide to establish between the pumping plants a drop of, say, 36 inches per mile instead of 18 inches, the flow of water naturally would be accelerated, thus requiring a pipe line of only about half the size now contemplated. This, it is said, would save some 60,000,000 dollars in the original cost of construction. But, it likewise would call for an additional 100,000 horsepower of electrical energy for all time to come. Indeed a very few inches, more or less, in the grade of this huge aqueduct will react in terms of millions in the cost of construction and operation.

THE BEGINNING OF THE WORK
Infiltration reservoir on the west bank of the Colorado

This condition presents a problem of such significance that it is being studied persistently at the present time. It was because of the pumping cost that the alternate plans came into existence, later to be rejected. Those in charge of the project know that the only way to carry the Colorado to Los Angeles is by means of an aqueduct, that the only way to get it over the mountains is by a pumping process, and that the force required to lift this huge volume of water to its highest level, once the maximum capacity has been reached, will amount annually to at least 250,000 horsepower of hydro-electric energy.

From this highest point, the water will run by gravity over the remaining 185 miles, finally reaching its impounding reservoirs at about the same elevation as its intake. This fact in itself offers intriguing possibilities. This 1,400-foot drop holds the same opportunity for electrical development as any other gravity proposition. In other words, they might build power plants along this 185 miles, thus regaining about 70 percent of the energy expended on the other side of the range, and at the same time, as one might say, play a practical joke on Nature.

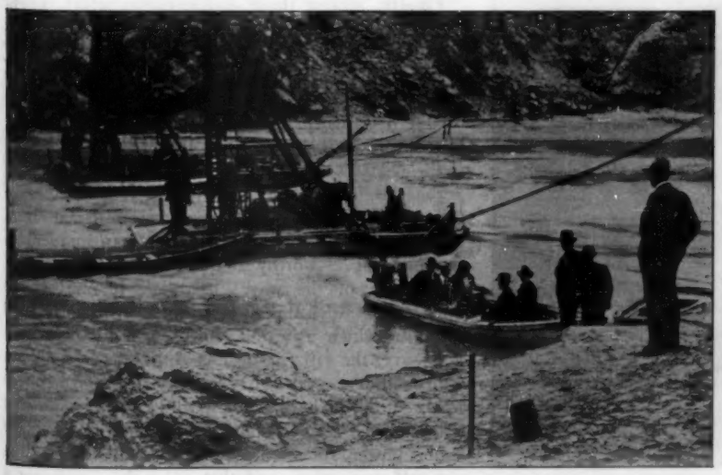
One of the interesting facts regarding this enterprise is found in its possibilities along cooperative lines. At the present writing, the aqueduct is being built by Los Angeles; that city has voted the first two bond issues, and it plans to finance, if need be, the entire enterprise. Meanwhile it has invited the other cities and towns of Southern California to join in the undertaking. Many of these have expressed a desire to do so, since they all are growing rapidly, and all in time must augment their domestic water-supplies.

1,500 Second-feet of Water

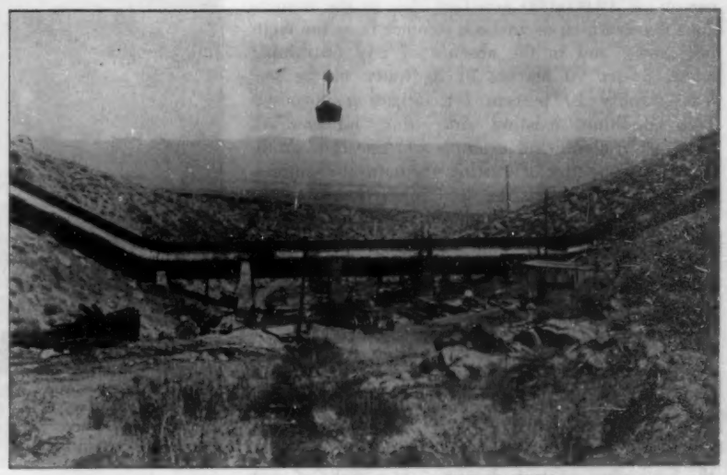
In the event of a cooperative arrangement, a metropolitan water district will be formed and the entire area will join in the construction cost, participating pro rata in the benefits. Such an outcome would establish a precedent in municipal cooperation. Boston has a metropolitan water district which serves a number of adjacent cities, although not in a manner, nor on a scale, commensurate with this. If the plan goes into effect it would include Redlands and Riverside, 90 miles to eastward; Pasadena, 15 miles away; Long Beach and Santa Monica, 20 miles west and south; Santa Barbara, 100 miles northwest; perhaps also San Diego, 140 miles distant on the border of Mexico; and some 50 other cities, towns and villages lying within a circumference of about 300 miles, an area which even now holds close to 3,000,000 people, and produces annually some 2,000,000,000 dollars worth of manufactured products.

Another plan is that Los Angeles finance the entire project, and then resell to the other communities. It is a plan that is now being carefully considered by all the region involved, although it does not in any way affect the larger plan, which is to bring a portion of the Colorado River from the Arizona line across to the coastal plain to meet an imperative demand.

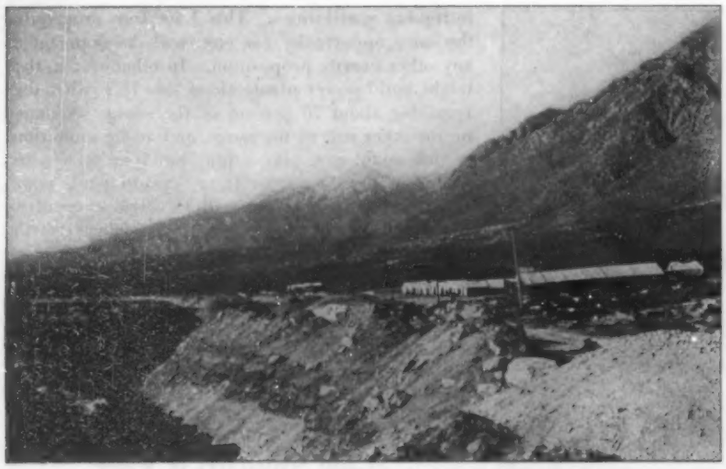
When this is achieved it will represent, as above stated, the largest domestic water project ever undertaken by a municipality. Its nearest competitor will be the Catskill system, serving New York City, which carries 1,000 second-feet, against 1,500 for the California project. The Catskill line is 101 miles long, while the Colorado aqueduct will travel a distance of 260 miles. That it *will* travel these



SOUNDING THE COLORADO FOR BED ROCK
Here the government dredges are making soundings at low-water, to locate bed rock in the Colorado River on the site of the proposed Boulder Dam



PART OF LOS ANGELES' PRESENT SYSTEM
The Owens River pipe line was constructed in five years, beginning in 1908. This line carries water 256 miles, from an elevation of 5,000 feet



CONSTRUCTION CAMP ON THE OWENS RIVER

This is a typical one of the camps where the laborers and engineers were housed. There will be 60 similar camps along the route of the Colorado project

AT WORK ON THE OWENS RIVER AQUEDUCT

The difficulties of the construction work are to be seen plainly here. Some of the new Colorado system will pass through country similar to that shown

260 miles is the one fact pre-eminent in the minds of all Californians. It will, because it must! Whatever obstacles present themselves will be met, and overcome.

As every conceivable outcome in our daily lives depends upon something else, so does this aqueduct; it depends to a large extent on the development of the Colorado River. And the Colorado is not yet developed, although it is in what might be termed "the throes of development," and has been for many years. These consist of a protracted struggle—now happily all but ended—between the seven states involved, over the apportionment of water; the political conflict, both local and national, for the control of the huge project, and the details of government legislation which, in the shape of various bills, have been continually before Congress for the past six years, and now seem to be approaching a favorable conclusion.

Many Problems Still Exist

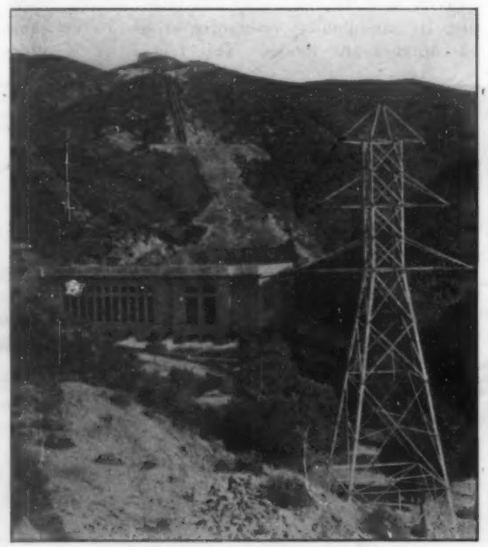
The reasons why the need for this development grows increasingly apparent, are three in number. First, flood-control for beleaguered Imperial Valley, a region of 1,000,000 acres of thrifty farms and towns, with 60,000 people who live far below the occasionally flood-mad Colorado—indeed far below sea level—and who each year spend 500,000 dollars to avoid destruction from these floods.

Second is the need to conserve the Colorado for irrigation and reclamation purposes. At the present status of affairs this river, with an annual average run-off of 13,000,000 acre-feet, due to the tremendous floods which occur each summer from the melting snows, and in the absence of any restraining dams, wastes 90 percent of its water in the sea, leaving only 10 percent for irrigation purposes. This condition, existing since time immemorial, furnishes a significant example of American prodigality in the matter of wasting our natural resources.

The third reason is the need for hydro-electricity to meet the growing demands of farms, mines and factories in the states of the Pacific Southwest, and this question brings us abruptly back to the Colorado River aqueduct. For this aqueduct, as above explained, will require in the delivery of its waters to their final destination, at least 250,000 horsepower of electrical energy, and this energy is not now available. Likewise, without an impounding reservoir, the aqueduct might fail to function through a dearth of water, since 90 percent of the river's annual run-off is now wasted in the sea, while the remaining amount, during eight months of each year, is barely sufficient to take care of present irrigation needs. Thus the aqueduct must depend upon the water which now is being wasted, and, in order to secure it, a storage dam must be built.

That this dam will be built, at some point along the river, in a manner to meet all the various needs, and that the construction work will begin at an early date, is no longer open to doubt. Realizing the urgency of the case, President Coolidge has recently made the question an administration measure and, together with the members of his cabinet, is bending every effort to perfect the details of a suitable plan, and to encourage the passage of legislation at the forthcoming session of Congress. If the Colorado River development should be delayed through a long series of years, at least seven of our southwestern states would suffer irreparably, while the plans for the future of Southern California would be seriously delayed. That the Government should permit such a condition to occur is as inconceivable as the thought that it might repudiate its Liberty Bonds, or its legal tender. Los Angeles will need this water and power some eight or nine years hence, and by that time no one questions that they will be available.

Beyond this fact, it is true that some cause for sleepless nights still does exist between this huge plan and its final consummation. There is a rumor of a salt deposit involving the basin which would be created by one of the proposed dams. This rumor has already called for a new geological survey. An appraisal of the facts has been highly reassuring, although the subject is still being carefully considered.



AN OWENS RIVER POWER PLANT

The water arrives through twin pipes, each 10 feet in diameter, and drops 900 feet down the canyon wall

Likewise, there is a possibility, although not a probability, of opposition to the aqueduct from some one of the other states. American politics often produce situations that no one can hope to understand. Yet such opposition—if it does occur—could cause but a brief delay, for the reason that under the law a call for water for domestic purposes takes precedence over all other demands.

175,000,000 Dollars Needed

There is likewise a situation which at first glance seems to constitute a gamble with the future. Observe that Los Angeles is now spending her third million dollars—and will continue to spend—on the building of an aqueduct to furnish water which has not yet been impounded within government reservoirs. One might contend that here is an unnecessary risk—that courage, vision and faith of an unusual sort are required to do such things. And so they are. Yet the element of risk has entered into every business venture that has ever been projected; all human endeavor moves forward in the face of an unknown future, whether it be the planting of crops, or the loaning of millions to some war-infested country. Belief in the fostering proclivities of the Government, and faith in our fellow men, are facts upon which all organized society is built, and, viewed in their broadest sense, are all but universal qualities.

Finally, among those contingencies which might be termed "grounds for anxiety," is the fact that there yet remains to be provided bond issues aggregating at least 175,000,000 dollars. Yet when these bond issues are printed on the ballots, no one in Southern California doubts that they will be voted by a large majority, because they believe that here is the next essential step in the building of a prosperous section of the country, and that all the details incident thereto must be viewed in the light of necessary obstacles, which halt for a moment in the path of a worthy undertaking, and then are forced out of the way. Likewise, if one should question the advisability of so huge an issue, added to those which a rapid growth has already made necessary, the citizens of Los Angeles will tell you with confident smiles that the city's present tax rate is low in the scale of municipalities of this size, that many of the former bond issues, such as those for water, power, and the harbor, represent projects that are self-supporting, and that a bond issue is not a liability anyway, but an investment, upon which the entire structure of a municipality is based.

Inventors Who Have Achieved Commercial Success

The Fourth Interview of This Series Is With the Inventor Who Has Perfected the Production of Animated Cartoons

By Milton Wright

INVENTIONS and cartoons. An odd combination, but one which has brought fame to Max Fleischer, originator of the noted "Out-of-the-Inkwell" series of comics which have become so popular with motion-picture audiences. His patented cut-out method of production has revolutionized the making of animated cartoons.

AN INVENTOR-ARTIST

Max Fleischer, shown in a combination photograph-drawing of the type used in some of his animated cartoons

Numerous "Out-of-the-Inkwell" pictures are made every year. They are shown in more than 4,000 theaters about the country. The task of producing them has become a complex one and the man who began by being a cartoonist and then turned inventor has had to evolve into a business executive of no mean proportions.

Think back to the last time you saw the animated cartoons in the theater. The funny clown and his little dog cavorted about the screen and assumed a thousand positions to the delight of the audience. Each line was drawn with pen and ink. It would appear to be an endless task to draw all those pictures! It used to be, but not now. The modern, economical way is Max Fleischer's.

A reel of motion picture film is 1,000 feet long and takes about twelve minutes to show on the screen. It is made up of about 16,000 separate photographs, each one inch long by three-quarters of an inch wide. Each of these photographs is called a frame. In animated cartoons there are about 4,000 separate pictures or frames, each repeated four times. The next four frames show a slightly different position of the figures, and so on. Projecting the whole reel of 16,000 frames rapidly on the screen—each view lasting one-sixteenth of a second—creates the illusion of continuous motion.

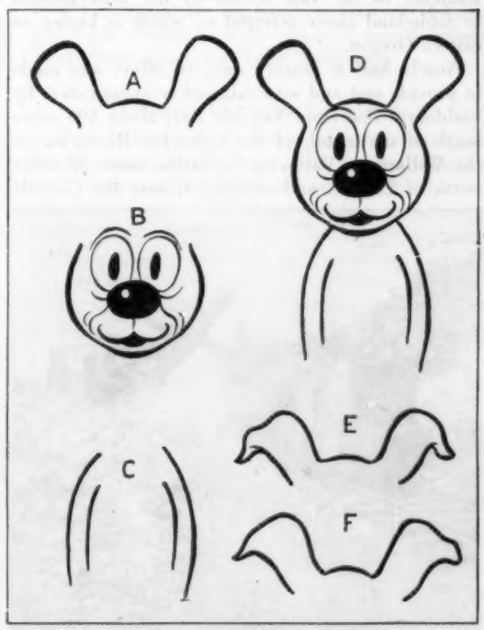
To draw 4,000 separate cartoons and photograph them one at a time was the practice in the early days. Then it dawned on some genius that parts of a figure remain motionless throughout several poses, so the practice of tracing was adopted; the altered parts were added by original drawing. Tracing, however, was never wholly satisfactory, for it seemed impossible to trace the lines unerringly and an impression of flickering was conveyed when the film was projected.

It was Fleischer's idea—which he patented—to cut out the stationary parts with a pair of scissors, laying the changed part on top in various positions. Each part could thus be used for many successive exposures.

In the making of an animated cartoon, five sets of persons are called on to co-operate—scenario writers, who build up the story; planners, who assemble and co-ordinate the scenes for the photographers; editors, who cut and edit the films; animators, and photographers. An animator is a cartoonist. In Fleischer's studios we found eight of them—all men, because women, according to persons in the business, do not seem to make good cartoonists. Each of these animators has practiced until he can draw a dog or a clown—the two standard characters in the Out-of-the-Inkwell series—exactly like all the other animators draw it.

The animator works over a piece of glass under which is an electric light. On the glass panel he places the drawing of a figure. Over this he places a sheet of blank paper. The light shining from beneath shows the picture on the under piece of paper through the top piece of paper. On this top piece of paper the animator draws the part of the figure which is to be in a slightly different position. Then he draws the next slightly different position of the same part, and so on until the whole series making up the complete action is finished. All these little parts of pictures are cut out and numbered consecutively.

It is essential that all the various portions fit or "register" exactly. The method of bringing this about is simplicity itself. All the sheets of paper are the same size and at precisely the same spots on each two holes are punched. When any sheet is laid on the table the holes are fitted over two little brass posts. This method of registering is carried throughout all the processes to which the drawings are subjected.



HOW A DOG IS ANIMATED

The ears; A, the head, B, and the body, C, are combined to form the picture D. In the finished film, the ears are made to appear to move by substituting the different ears E and F, and exposing several frames of each

Now comes the work of the photographer. The drawing is laid on a table. Suspended directly above it is the camera; it has a device on it that makes it possible for the operator to work the mechanism by pressing down her foot.

Before taking each picture, the photographer presses a pane of glass over the paper. This is to keep the drawing flat. Having taken the first picture, she lifts up the pane of glass, lays down the second picture of the series, puts down the glass panel, and makes the next photograph. This second picture, you will remember, is made up of two drawings: the main body, which is the same as the first picture, and a cut-out drawing laid over the first in a slightly different position. The place where the cut edge meets the original picture does not show because it is pressed flat by the glass. The following picture is taken in the same way until the whole scene is completed.

AN ANIMATOR AT WORK

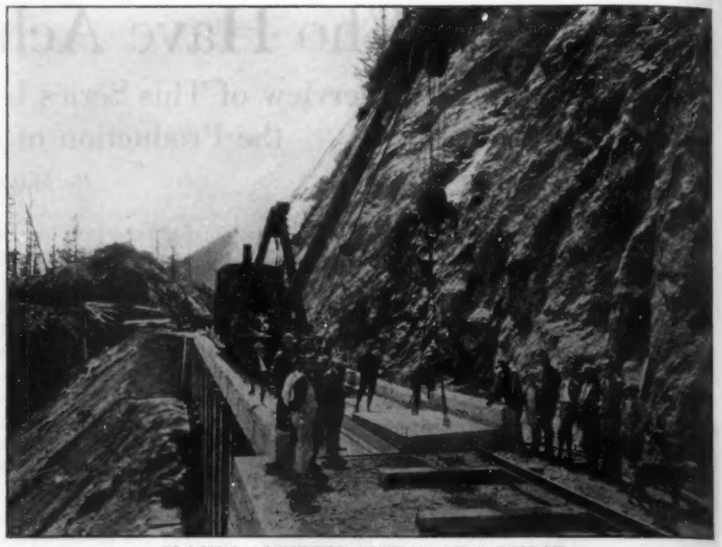
This is the type of drawing board on which the pictures are made. The artist works on a glass sheet under which is an electric light which serves to show the lines on the paper under the drawing on which work is being done. In this way, perfect alignment of all parts is obtained

For showing hand-drawn cartoons in the same scene with photographs, Fleischer has devised the Rotograph. In a horizontal table is set a piece of translucent glass. A projector throws a motion picture through and on to the glass from below. Above is a camera pointed downward. The film being projected is stopped at each frame while the animated cartoon posture is superimposed on the picture and photographed.

Later Fleischer perfected the Novograph, a slow-motion camera which suspends action at any desired stage. The latest of his innovations is a "song motion-picture film" which is causing audiences throughout the country to join in singing while a little cartoon runs and skips from one word to another of popular melodies flashed on the screen.

CLEARING THE RIGHT-OF-WAY

One stretch of the Natron Cut-off ran through this dense forest. For the protection of both the road and the valuable surrounding forest, 100 to 200 feet are cleared of timber



PLACING CONCRETE SECTION OF A BRIDGE

This photograph shows the first-class character of the construction. In place of the pile trestles and Howe truss-bridges of timber, bridges are of pre-cast reinforced concrete

Twentieth-Century Railroad Building

Thirty-nine Million Dollars Spent to Improve the Railroad Connection Between Oregon and California. Natron Cut-off Reduces Grades and Curvature, and Opens Up a Great Area of Undeveloped Country

THOSE of us who live in the thickly populated and highly industrialized sections of the United States are apt to think of modern railroad construction as consisting merely in the replacement of bridges, the substitution of heavier steel rails for the older and lighter rails, and perhaps the occasional straightening out of curvatures and cutting down of grades on a countryside that is already highly developed.

We present in this article, however, a series of illustrations which show that entirely new construction is being carried on in vast stretches of country which have never heard the sound of a locomotive whistle. In doing this work, the engineer has to face physical difficulties in the way of precipitous mountains, deep canyons, and far-spreading forests, similar to those which were encountered half a century ago or more when the pioneer railroads were being driven through the mountainous regions of western America.

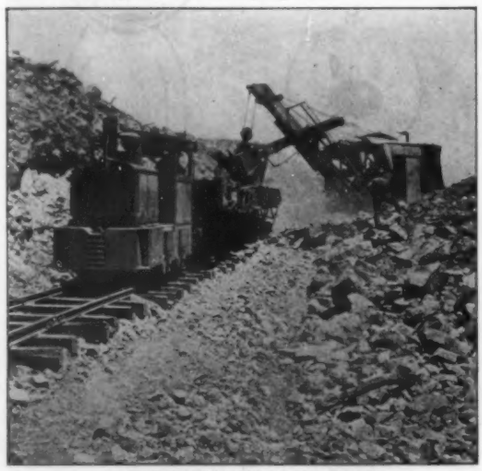
Planned and Abandoned 50 Years Ago

Hardy men were the locating engineers of the early railroads of the United States. Often, with nothing more than a compass, they explored the unknown passes of the mountain ranges, seeking a way for the steel tracks and the locomotive. Considering the limitations imposed by scarcity of capital, their work was meritorious and worthy of all honor.

Geographically and physically, Oregon is divided into two distinct portions—western Oregon, a fertile and well-watered country, lying between the Cascade Mountains and the Pacific Coast; and eastern Oregon, a relatively dry and lofty tableland, consisting chiefly of grazing, or as the local inhabitants call it "bunch grass" and "sage brush" land, which reaches from the Cascade Mountains to the Snake River. Between the coast and the Cascade Mountains lies the famous Willamette Valley, through which, for over 150 miles, flows the Willamette River.

The original builders of the railroad between Portland and San Francisco naturally ran their lines down the Willamette Valley to Eugene, at which point several tributaries of the Willamette meet to form the main river. From Eugene on to the south, they developed the line through a hilly country, carrying it finally over the Siskiyou Mountains into California. This route is subject to two disadvantages; first, it involved some extremely heavy grades over the Siskiyou Mountains with consequent heavy costs of operation, and secondly, it gave no service whatever to the vast stretch of the high plateau or table-land above referred to, which is known as eastern Oregon.

Nearly half a century ago, an effort was made to provide east and west railroad communication by building a line from Yaquina Bay, about 100 miles south of the mouth of the Columbia River, across the Willamette Valley at Corvallis, some 30 miles north of Eugene, and carrying it over the Cascade Mountains and through eastern Oregon to connect with a westerly extension of the Chicago and Northwestern Railway at Boise City, Idaho. This railroad was completed from the coast, across the Willamette Valley, and up the western slope of the Cascade Mountains, but due to the panic of 1893, the enterprise collapsed and the road subsequently passed into the hands of the Southern Pacific Railway.



A CUT THROUGH LAVA ROCK

The line passes through an interesting region of comparatively recent geological formation containing lava beds

It is this company which has completed what is known as the Natron Cut-off, which provides railroad communication with Portland and San Francisco for the eastern Oregon country, avoids the difficult and costly Siskiyou Mountain grades, and provides a first-class road, with relatively light grades, and easy curvatures. This new line, 280 miles in length, has cost nearly forty million dollars.

The "Ruling Grade" Decides Profits

It may naturally be asked how a line can be built through a rather sparsely settled country at a cost of over 139,000 dollars per mile with a reasonable expectation of realizing any profit on the investment. The answer is to be found in those operating conditions which render the Natron Cut-off a far more economical line to operate than the old line. To use a phrase familiar to railroad men, "the ruling grade" is of supreme importance from the standpoint of operation. The ruling grade is the maximum which is encountered by a locomotive in hauling a train over a given stretch of line. A locomotive can haul a given number of passengers or freight cars over a level country, but if, during the journey, it encounters a steep grade, it would either fail to "make the grade" or, in order to do so, it must have the assistance of one or more locomotives. That stretch of more or less steep grade is the ruling grade and it determines the load which a single locomotive can haul over that particular part of the line. Hence, it is important that the locating engineer who determines where the line shall run, shall so lay out his line, with regard to

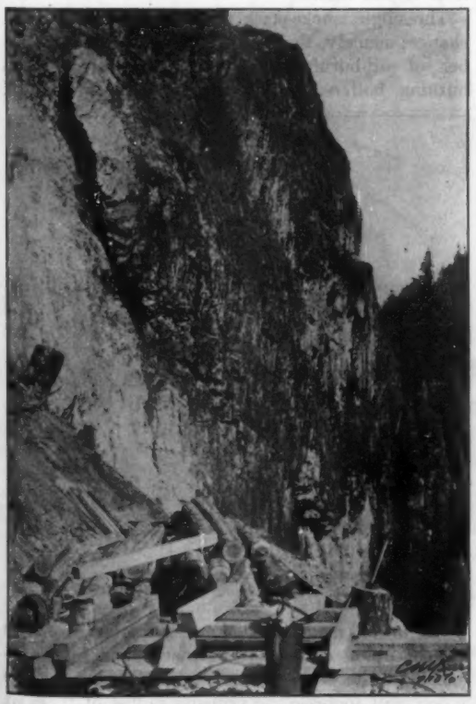
the topographical features of the country, as to keep his maximum grades down to the lowest practicable limits. Anyone will understand that the use of double-headers at the front of the train and of a pusher behind, necessitates the continual keeping in service of costly locomotives and their crews which, for considerable periods of time, must be idle in the round-house.

The new Natron Cut-off reduces the maximum grades about one-half as compared with the old line. Nor is that all. Another physical fact which limits the maximum load is the amount of curvature. Due to the fact that the outer wheel on an axle in going around a curve travels somewhat further than the inner wheel, there is a certain amount of slipping by either the outer or inner wheel, with a consequent increase of friction. Furthermore, in rounding a curve, the flanges of the outer wheels rub more or less heavily against the outer rail, and this also results in friction and a retarding effect. Hence, the locating engineer endeavors to keep down the total amount of curvature. In the Natron Cut-off, there are eliminated over fifty complete circles of curvature as compared with the old line. Furthermore, the total distance has been reduced by over twenty-three miles. From these considerations, the reader will understand that the hauling of the heavy freight and passenger trains between Portland and San Francisco can now be done at a far less total cost of operation, and it must be remembered that this saving continues indefinitely.

The following description of the principal engineering features of the line is from a contributor on the Pacific Coast who is thoroughly familiar with this great work:

The Natron Cut-off, a second track on the Shasta Route extending from Black Butte, California, to Springfield Junction, three miles south of Eugene, Oregon, was turned over for operation on September 1, 1926, and has been officially designated as the Cascades line of the Shasta Route.

The Cascades line, with the Black Butte–Grass Lake line change, has involved a total expenditure of more than 39,000,000 dollars. Among other advantages, the new line reduces the maximum grade between San Francisco and Portland from 170 to



NORTH END, TUNNEL NUMBER ONE

This gives a graphic view of the difficulties of construction. A tunnel was driven through this towering precipice

MAP SHOWING NATRON CUT-OFF

The Southern Pacific Line (left) was tortuous and hilly. The new line is straighter and grades are much easier

95 feet per mile, reduces the distance 23.7 miles and reduces the total curvature by 18,458 degrees, or about 51 complete circles. The most difficult part of the construction was between Oakridge and the summit of the Cascades, on the west slope of the mountains. Here the maximum grade is 95 feet to the mile, with the sharpest curve in an arc of eight degrees. In this distance there are 19 tunnels having an aggregate length of 19,662 feet. The longest tunnel (3,648 feet), is at the summit and at an elevation of 4,842 feet. The shortest tunnel is 150 feet long. Nearly all the tunnels are bored through solid rock and, aside from the concrete portals, little concrete lining was required.

An average of 3,000 men was employed during the summer and fall of 1924, the size of the crews varying with the season. A total of approximately 4,000,000 cubic yards of all classes of material were handled in the construction between Oakridge and Kirk, exclusive of the 24-mile cut-off between Black Butte and Grass Lake, California.

Cutting Through Lava Beds

Many miles of wagon roads and trails were built on the mountain sides to enable the contractors to haul equipment, material and supplies to the various camps and points of construction. Due to excessive cost and difficulty of hauling timber, small sawmills were established at convenient points in the forests in order to supply lumber. The right-of-way between Oakridge and the summit was cleared through thick forests.

The Black Butte–Grass Lake line change known as the Black Butte Cut-off, which was built as part of the Natron Cut-off, connects the south end of the latter with the main line of the Southern Pacific Shasta route and replaces the present line originally built as a lumber railroad between Weed and Grass Lake. This old line has grades up to 4 percent and such sharp curves that the heavy main-line trains to be run over the Natron Cut-off could not be operated over it with speed and efficiency. The new line, the Black Butte Cut-off, is 4.7 miles shorter, has 3,540 degrees less of total curvature, 80 fewer curves and 713.1 feet less in grade rise in both directions. It will permit faster running time, less helper service and cheaper maintenance.

The Black Butte Cut-off passes through an interesting region of comparatively recent geological formation, containing lava beds which are broken up into big boulders and are devoid of vegetation. Nowhere in North America, except possibly in a portion of Mexico, are there such large lava flows of recent deposit.

The construction of this section cost approximately 4,000,000 dollars and involved the excavation of 2,000,000 cubic yards of material. There are 12 rock cuts whose depths vary from 35 to 95 feet. One steel viaduct 1,140 feet long and 160 feet high, was erected on the new line. At one time the contractors had established ten working camps of 800 men. Twenty-six steam shovels were used on the job. The work on this line was begun October 20, 1925, and was completed last autumn.

The first work on the Natron Cut-off was begun at Natron, Oregon, in 1909; by May 1, 1912, 33 miles of the track were laid south of that point to as far as Oakridge. In July, 1911, work was started at Klamath Falls and the track laid to Chiloquin. By September, 1912, the railroad had been pushed farther north, until it reached Kirk, a total distance of 40 miles from Klamath Falls. Work on the remaining 110-mile gap between Kirk and Oakridge was then stopped, chiefly on account of the litigation involved in the famous Central Pacific case and also because of the World War. On September 1, 1923, work was resumed at Kirk and has been continued diligently since, in keeping with the promise made to the people of Oregon by the Southern

A "Y" BLASTED INTO THE HILLSIDE

At the Cascade Summit a "Y" was necessary. No ground was available, so it was driven into the mountain

Pacific Company during the Central Pacific controversy.

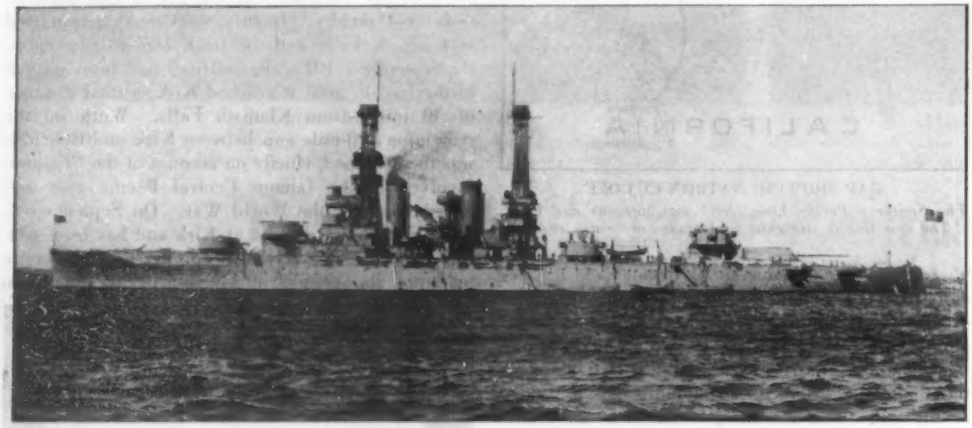
There were several important factors which prompted the construction of the Natron Cut-off and the Black Butte Cut-off. The major purpose was to reach a great area of undeveloped country and virgin timberland and help build up the territory by securing direct railroad connection with the Willamette Valley and Portland. The other advantages, including those which accrue from the completion of the Black Butte Cut-off, embrace marked improvements over the old line, as mentioned above. The line as now completed has a fine roadbed and compares favorably with the best rail lines in the world.

The Reconstructed Battleship "Texas"

Blisters Below Water, Heavier Deck Armor, Improved Boilers, Tripod Masts and Larger Cruising Radius, Render the "Texas" a Far More Efficient Ship

By J. Bernard Walker

A PASSING glance at the illustrations on this page would lead one to suppose they showed two entirely different ships. As a matter of fact, they are views of the same ship, the *Texas;* one showing her as she was built in 1914, the other representing her as she steamed out of Hampton Roads, recently, for Guantanamo Bay, after a thorough reconstruction and refitting at the Norfolk Navy Yard.



BATTLESHIP "TEXAS," BUILT IN 1914

The Texas was regarded as the last word in battleship design. Length 573 feet, displacement 28,367 tons; Armor: belt, 12 inches; turrets, 14 inches; deck, 3 inches. Guns: ten 14-inch; sixteen five-inch. Speed, 21 knots

The change in her external appearance is so complete that it takes the eye of an expert to recognize the new *Texas* as being, in its essentials, the same as the original ship; for although the hull and the turrets with their ten 14-inch guns are the same, everything else—masting, smoke-pipes, the position of the secondary battery, and indeed the whole superstructure—has undergone radical changes, both as to form and location.

Every one of these changes was made for a sound military reason. The result is that the new *Texas* is a far more efficient fighting unit than the old, particularly in her defensive qualities. Moreover, considered as a battleship, her appearance has been greatly improved. The clean-cut tripod masts, the single smoke-pipe, and the reduction of "top hamper" cause her, more than ever, to look the part of an up-to-date, first-class battleship.

The *Texas* is one of the six older ships of our Treaty Navy which the Navy Department decided to modernize. This work has been completed on the *Texas, Arkansas* and *Florida.* Similar alterations are now being made on the *New York, Wyoming* and *Utah,* which will be ready for sea in their new silhouette form by the end of 1927.

The *Texas* and her sister, the *New York,* were laid down in 1911 and completed in 1914. Like their immediate predecessors, the *Arkansas* and the *Wyoming,* they are flush-deck ships; that is to say, the upper deck slopes in a straight line, without any break, from a freeboard of about 22 feet at the bow to a freeboard of about 13 feet at the stern. The same characteristic is to be found in all our later destroyers, as built during the war.

The over-all length is 573 feet; beam 95 feet, two and one-half inches; maximum draft, 29 feet, seven inches; full load displacement, 28,367 tons. She has a 12-inch belt, above which is an upper belt nine inches to six inches thick. She has 14 inches of armor on the turrets, 12 inches on the barbettes to protect the ammunition hoists, and 12 inches on the conning tower. Originally, her protective deck, covering the vitals (magazines, boilers, engines and steering gear) was three inches in thickness. This deck has been strengthened by additional steel plating, as a defense against aerial bombs and high-angle gun fire.

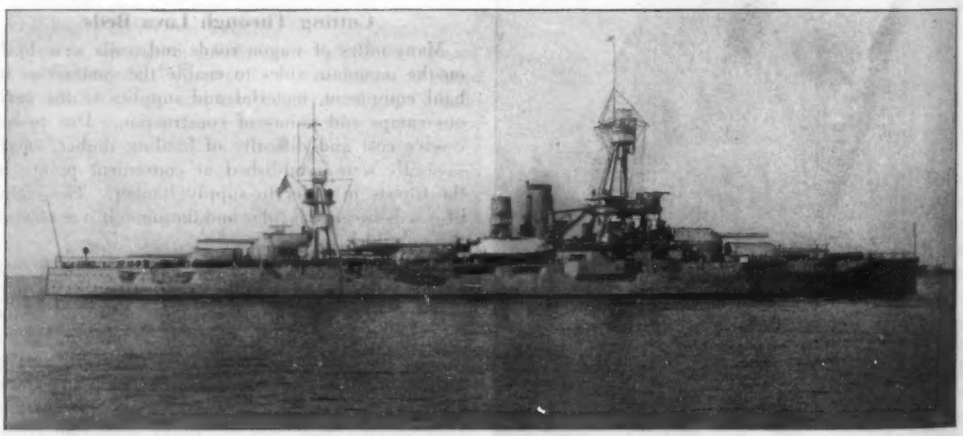
High-angle fire is the term used to describe the fire from guns that are discharged at high angles of elevation. In our latest battleship this reaches a maximum of 30 degrees. Before the war, it was considered that 10,000 yards was the probable extreme range at which sea battles would be fought, and battle practise was carried on at 9,000 to 10,000 yards. At this range the angle of fall was about seven degrees, and hence the heavy vertical armor with three inches of horizontal deck protection was considered a good defense of the interior of the ship. But the British raised their elevation from 15 to 20 degrees, and we, in our latest ships, have gone up to 30 degrees. With these elevations the shells, falling from 24,000 to 35,000 yards distant, will drop on a ship at angles of, say, from over 20 to over 30 degrees. Hence they might clear the top of the heavy side-armor, and penetrate the light protective deck with disastrous effect. Therefore, all the first-class navies are greatly increasing the thickness not only of their protective decks but of one or more of the decks above.

Another most important protective system in the *Texas* is the addition of bulges to the hull below the waterline. The bulge or blister was developed during the war. The British tried it out on some monitors that were sent out to the Dardanelles. It worked well as a defense against torpedoes and was adopted for all future ships. It consists of a hollow chamber, several feet wide, built upon each side of the hull of the ship below the waterline, and extending practically for her whole length. When a torpedo strikes the blister and detonates, the gases expand within the hollow spaces and fail to crush the hull itself. Although one of the monitors engaged at the Dardenelles was torpedoed more than once, it was nevertheless able to navigate thereafter.

The secondary battery of five-inch guns has been improved by raising six of these guns from the gun deck to the upper deck, where they will be well above the seas and spray which hitherto have interfered with the forward guns in rough weather. Note the sponsoned-out casemate abreast of the foremast.

Another notable change is the substitution of tripod masts for the old cage or lattice masts. These are much stiffer and afford a steadier platform for the spotter and the delicate instruments in the fire-control houses at the top of the mast. Our old lattice masts were favored because they could be hit without being destroyed; but the British ships went through the ordeal of Jutland without losing any of their tripod masts.

The single smoke-stack tells of another important change; namely, the substitution of a smaller number of oil-burning boilers for the former coal-burning boilers. Oil-burning boilers for all six ships to be modernized were available from the eleven capital ships that were scrapped in accordance with the Washington Treaty. The new motive power will increase the cruising radius of these six ships to that of the other twelve battleships of the United States fleet.



THE "TEXAS" AFTER RECONSTRUCTION

The modernization of the Texas has been very thorough. It includes new water-tube boilers and removal of one stack; substitution of tripod for lattice masts; thickening of the decks, and blisters below the waterline

The Escape of "Old Ironsides"

Was the Famous Ship Saved by the Threefold Means of Towing by the Ship's Boats, Kedge Anchors, and Extemporized Canvas Sea Anchors?

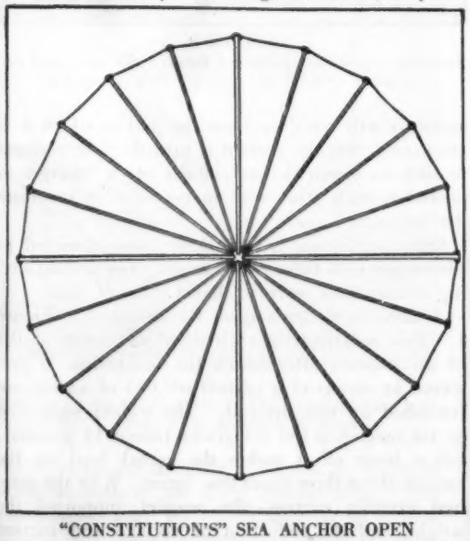
By William Allen

IN our issue of December, 1925, we published sketches and a description of the extemporized "umbrella," or sea anchor, which enabled the *Constitution* to draw away from the British squadron. The account was sent to us by Mr. William H. Woodwell, a direct descendant of Gideon Woodwell who was carpenter aboard the *Constitution* during her flight. The story consisted of extracts from the notes of Gideon Woodwell which are still in the possession of the family.

The sea anchor was hastily manufactured from canvas and several sticks of white oak which happened to be in the lower hold of the *Constitution*. As shown in the accompanying drawing, it had a diameter when open, of from 20 to 24 feet. "In pulling from the ship," said Gideon Woodwell, "the umbrella would shut up, and in pulling on board, the umbrella would open."

In the *United States Naval Institute Proceedings* of August, 1926, there was published a photograph which, by the courtesy of the Institute, we are enabled to reproduce herewith. This shows what purports to be the sea anchor used by the *Constitution*. Lieutenant Commander H. D. McHenry of the United States Navy, in his article accompanying the picture, states that Rear-Admiral George F. Winslow of the Navy found this interesting relic in a corner of the spar shed at the Boston Navy Yard.

"After carefully examining the anchor," says the

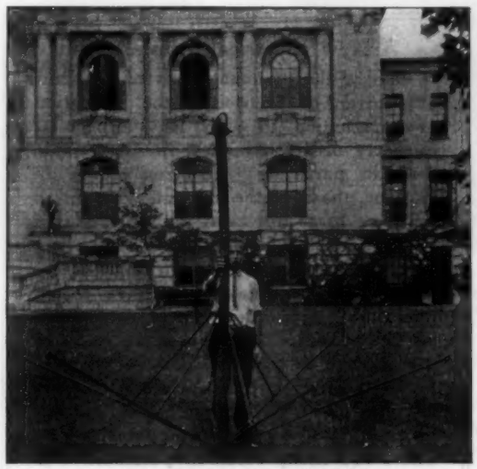


"CONSTITUTION'S" SEA ANCHOR OPEN

A top view of the wood-and-canvas sea anchor built hastily, while the ship was endeavoring to escape from the enemy

Admiral, "I made up my mind that this anchor was no other than the kedge anchor with which Captain Hull was enabled to haul his ship away from the British squadron." This kedge is now in the museum at Annapolis. It consists of a central stock, eight feet, six inches in length, with ribs, rings, shackles, et cetera, of wrought iron. It is supposed to have been covered with canvas.

Now, is this the actual kedge used on the *Constitution*, or was the wood-and-canvas kedge, as described by the ship's carpenter, the one which helped the good ship to escape? Kedging was a well-recognized expedient in the navies of those days,



RELIC OF "OLD IRONSIDES"

This sea anchor was discovered in 1868, lying in a corner of the spar-shed at Boston

and we think it was likely, if not indeed certain, that a stock of these kedges was kept on hand at the yards, to be dealt out to ships as they were called for. "Old Ironsides" may have been without one of these stock anchors, and therefore, when pursued, it was decided to build one hastily with such materials as were at hand. The general similarity between the Gideon Woodwell sea anchor, or drag, and the one that was found at the Boston Navy Yard will be evident at a glance.

The Proof Seems Conclusive

Thanks to the indefatigable efforts of Rear-Admiral Elliot Snow of the Navy, who is carrying on a very thorough search for historical data bearing on the escape of the *Constitution*, it is likely that the exact facts will, before long, be well established. We are indebted to him for the following confirmation of the Gideon Woodwell story. "His granddaughter, Mrs. Betsy Junkers, on the occasion of celebrating her 87th birthday, December 31, 1897, told the following bit of her early life history, which was published in a Newburyport (Massachusetts) paper, December 31, 1897. Speaking of her grandfather, she said that, after his return from the War (meaning the Revolutionary War, during which he participated in the naval engagement between the *Civil Usage* and the *Orient*) her grandfather helped build the historic frigate *Constitution* in 1797. In 1812, when the *Constitution* escaped from a fleet of British men-of-war by means of umbrellas, her grandfather was a ship's carpenter on board the frigate and helped construct the umbrella."

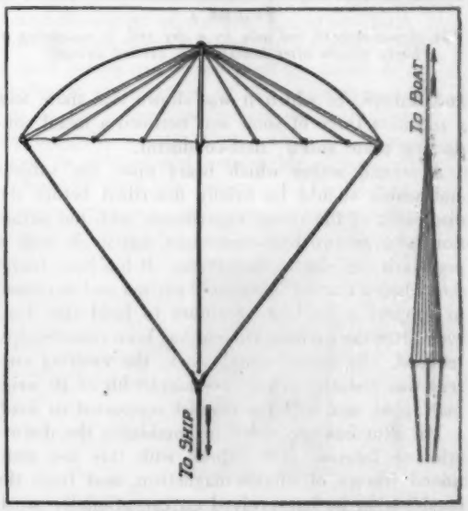
Admiral Snow writes us that, at the time "Aunt Betsy," as she was called, made the statement, she was in full possession of all her faculties. He was also informed that the descendants of Mrs. Junkers are living in Portsmouth, New Hampshire, and the descendants of Gideon Woodwell in Newburyport, Massachusetts.

This explicit confirmation of Gideon's story, as contained in his notes, would surely seem to be conclusive that his sea anchor, built as soon as the pursuit started, was used in hauling the *Constitution* away from the British squadron.

At the same time, we have the separate testimony of Lieutenant Morris, Surgeon Evans, and Moses Smith, of Gun Number 1, who were on the *Constitution* that kedging with a deep-sea anchor was resorted to. When the chase commenced, soundings showed the frigate to be in 26 fathoms, and it is probable that the delay in getting the anchor up from the bottom, 156 feet below the ship, and placing it aboard the ship's boats, may have suggested the use of a light wood-and-canvas sea anchor as an auxiliary to the kedge. A kedge, to be serviceable for such a heavy ship as the *Constitution*, must have been of considerable weight, and could not of course, have been handled as expeditiously as a light wood-and-canvas sea anchor. It is probable that both were used. Thus, in a recent letter from Mr. M. O. C. Hull, the grandson of Commodore Isaac Hull, written to Rear-Admiral Snow, Mr. Hull says, "Our escape was *greatly aided* by the adroit use of a sea anchor."—this being his conception of the phrasing of Commodore Hull's memorandum on this maneuver.

Lastly, it is known that the *Constitution* on this occasion carried four large boats, varying from 22 to 33 feet in length, and it is reasonable to suppose that she had one, or possibly several additional boats on board. Her crew numbered about 500 men, and it is likely that she put every boat afloat, and that every one of her men was putting his full weight into the moving of the gallant ship, either walking away with the lines attached to the kedge and sea anchor, or bending to the oars in the boats that were towing the ship.

It is quite possible that there are descendents of



SEA ANCHOR OPEN AND CLOSED

When boats were towing anchor, it closed. When ship's crew hauled away, the "umbrella" opened, serving as drag

those who took part in the escape of the *Constitution*, who have in their possession letters or memoranda that would throw light upon those stirring maneuvers off the Jersey coast. If so, we suggest that they send them to this office with permission to publish them. The publication of material of this kind will not only add to the historical record of the famous ship, but it will aid materially in awakening interest in the drive to secure funds for its reconstruction. If the possessors of such data object to publication, we suggest that they send them to the Secretary of the Navy.

Sensitive Relays Without Magnets

An Unusual Adhesive Force Between Partial Conductors of Electricity Makes Possible These Unique Relays

By Dr. Alfred Gradenwitz

RECENT experiments conducted by Mr. W. Blut, of Berlin, appear at the present time to hold forth promise of some interesting developments in a heretofore little-explored phase of electricity. Working with various potentials within commercial limits, Mr. Blut has observed a peculiar attractive force exerted between two partial conductors of electricity when they are in contact. At the same time, it has been noted that some materials, ordinarily classed as insulators, will carry an appreciable current of electricity.

The present announcement will call to the minds of many of our readers the experiments made several years ago by two Danish scientists, Johnson and Rabeck, in which it was shown that there was a retentive force of some sort between a metal conducting plate and a "half-conductor."

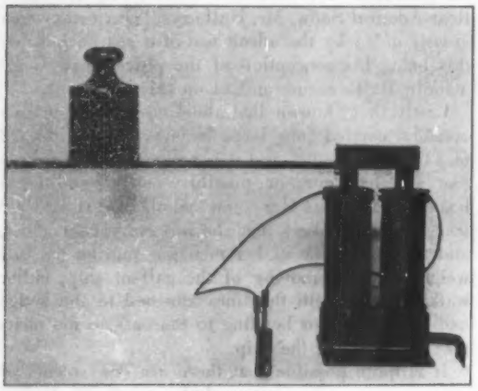


FIGURE 1

The electro-magnet, fed only by a dry cell, is sustaining a heavy weight after having been excited strongly

A second action which bears upon the subject and which should be briefly described before the discussion of the recent experiments with the attraction between two half-conductors, has to do with a peculiarity of electro-magnetism. It has been found that when a magnet is strongly excited and is caused to support a load, it continues to hold that load even after the exciting current has been considerably reduced. In experimental work, the exciting current was reduced to one one-hundredth of its original value, and still the magnet supported its load.

Mr. Blut has succeeded in combining the discoveries of Johnson and Rabeck with this last mentioned feature of electro-magnetism, and from the combination he has evolved an exceptionally sensitive relay designed to be used in connection with burglar alarms and similar devices.

The relay has also furnished the basis for experiments on the properties of half-conductors and it has been quite definitely ascertained, it is said, that the force holding together a metallic plate and a partial conductor, such as slate, is not in any way similar to the attractive force between the plates of a charged condenser. Rather, it is due to a direct passage of current from one of the electrodes to the other. In the case of one slate and one metallic electrode, the actual current flowing was found to be .00002 of an ampere.

In the course of further experiments in which it was attempted to reduce the current to a still lower value, currents as low as one-millionth of an ampere were utilized. It was found that even a wooden floor or a strip of linoleum would carry sufficient current to cause the two electrodes to adhere. Of course, switches and keys, as well as other apparatus, mounted on wooden bases were of little value in this work, as the wood itself carried sufficient current to upset all calculations and measurements. This knowledge led to other trials which established firmly that wood could be used as a really practical conductor of electricity for many purposes.

Not only was wood used as a conductor, but when two current-carrying pieces of this material were brought in contact and the current allowed to flow, there was found to be a distinct force holding the parts together. This was true to such an extent that experiment showed that, as long as the current was flowing, one of the pieces would support the other, but that the supported one would drop if the current was cut off, or in fact if even a small part of it was diverted by some means or other.

When all of the facts available had been assembled and considered, it was concluded that only a perfectly normal force was at work. This, according to the theory advanced by Mr. Blut, was brought about because electrical charges always attempt to neutralize each other. In the particular case under consideration, these charges, together with their bearers, travel through the partial conductors. It is said that when the charges meet at the junction of the two wooden parts, there is not, as might be supposed, a complete neutralization. Because of the continual replenishment of current there is a continuous current flow and a clinging together of the wooden parts. Thus this attraction is continuous, because of the constant struggle of the charges to become compensated and their inability to do so. The unusually high resistance of the complete circuit aids the action, as it delays any perfect compensation and thus affords a basis for the theory.

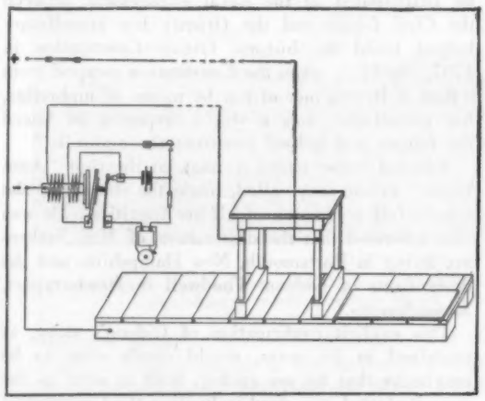


FIGURE 3

The circuit of the "breath current" relay. The same local battery is used for energizing and alarm purposes

When a relay operating on the principle just described is placed in operation and closed, the armature will not drop from the part to which it is attracted unless the current is turned off or reduced to such an extent that the efforts of the charges to neutralize each other will no longer serve to create the necessary force.

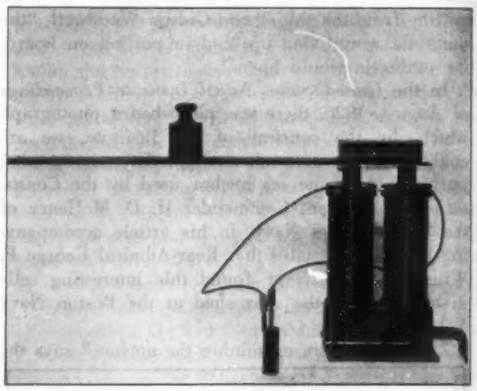


FIGURE 2

Inserting a piece of card-board between the poles and the armature weakens but does not destroy the field

Other significant actions have been observed in connection with these experiments. The accompanying illustrations serve to depict most of them.

A 220-volt electro-magnet is illustrated in Figure 1. This is primarily excited by a current of 0.2 of an ampere, after which the magnetism is preserved by means of a current of .004 of an ampere furnished by one dry-cell. The weight supported by the magnet is five kilograms (about 11 pounds), but a lever effect makes the actual load on the magnet about three times this figure. With the original exciting current, the magnet supported the weight, and the reduction of voltage and current made no difference in its retaining ability.

Figure 2 illustrates a further electro-magnetic experiment. Here a piece of cardboard has been inserted between the poles of the magnet and the iron bar. The influence of the magnet, excited only by the dry-cell, is still sufficient to sustain the weight, this time of three kilograms (about 6.6 pounds), after the initial force has been exerted by the action of the larger current and higher voltage.

Figure 3 shows the connections of a newly developed relay which makes use of the principles described above. The relay itself consists of an attraction coil, an armature and a contact of semi-conductive nature. Because of the minute currents of electricity that are used in its operation, the inven-

A New Electrical Application

One of the manifestations of the flow of a current of electricity is the generation of a magnetic field which has the peculiar property of attracting or moving certain metallic particles. Now we come to another phase of the subject, wherein an adhesive force not even remotely related to magnetism is shown. Already applications for this force have been found in the construction of relays that have rather remarkable properties. These instruments use the adhesive force that is the result of the passage of a minute current of electricity through partial conductors that are in contact with each other. The adhesive force is manifested at the contact point. There are many research possibilities in this work. ***—The Editor.***

FIGURE 4

A practical demonstration of the new relay. Touching the lid of the cigar box will shunt enough current to cause the relay to operate and close another circuit

FIGURE 5

Another demonstration of the relay. The hard-rubber rod has been electrified. As it is approached to the table or box, the relay will be actuated instantly

tor of this device has termed it the "breath current" relay.

In operation, this sensitive instrument functions in the following manner:

A local battery, controlled by a key, energizes the coil and attracts the armature. The latter makes contact with the semi-conductive material and a minute current passes through the junction. The action of this passage is sufficient, as explained

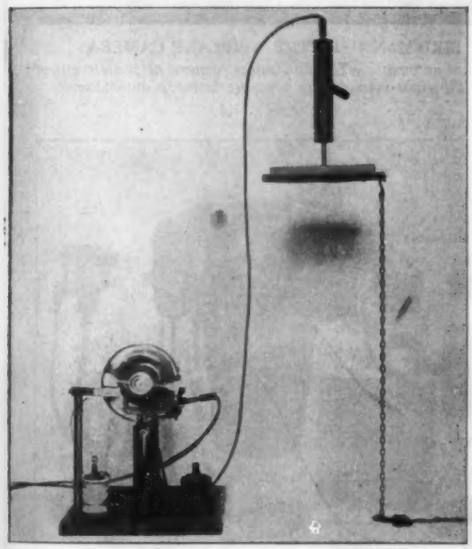


FIGURE 6

Demonstrating the adhesive force. The two planks are held together as long as the generator is operated

above, to cause the armature to remain in its raised position, as long as the slight current flows. The semi-conductor may be wood, slate or a similar material. The minute current that serves to retain the armature is furnished from the lighting mains at a potential of 220 volts. The positive terminal of the mains is connected to a slate resistance of about 200,000,000 ohms (200 megohms). From here it goes to an ordinary wooden table, well insulated from the ground, and thence to the relay. The return circuit is from the relay to the negative side of the lighting main.

When the apparatus has been connected as described, and the relay has been closed by means of the local battery, any interference with the circuit will result in the dropping of the armature. In actual work, this armature would be equipped with contacts which would close a local circuit and sound an alarm or perform other work as desired. If, for example, a person were to touch the table and thus form a shunt path through which part of the armature-retaining current would flow, the adhesion between the armature and the semi-conducting surface would become lessened and the armature would drop.

Figure 4 shows a practical relay which depends on this action for its operation. If even the lid of the cigar box or a book or other object on the table be touched the relay will be actuated.

The operation of the delay may be effected not only by touching the table but also by breaking one of the leads, or by bringing a charged body close to part of the circuit and so upsetting its electrical balance. If, for example, a hard-rubber rod be briskly rubbed and brought toward the insulated table (see Figure 5), an action will take place in the circuit which will cause the armature to be dropped. If the charge generated on the hard-rubber body is strong enough, this same effect will be noted even at a distance of several feet.

In the arrangement shown in Figure 6, two small planks are connected to a small frictional-electricity machine and are firmly held together as long as the generating machine is kept in continuous operation.

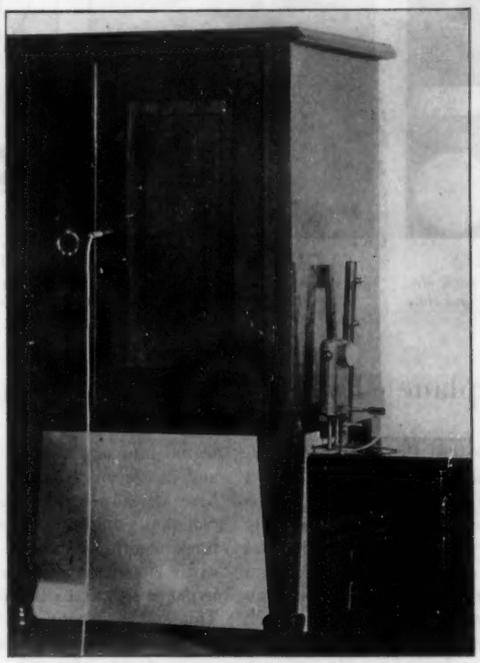


FIGURE 8

This all-wood relay uses no metallic contacts in its circuits, yet it functions with remarkable reliability

In Figure 7, the 220-volt current passes through a slate resistance of 220 megohms, through the wooden box and the wooden bar leaning against it and thence through the table to the other side of the main. The wooden bar is balanced on the metallic points and a plate so that, unless held in place by electrostatic attraction, it would fall by the mere force of gravity.

Figure 8 illustrates a special form of relay constructed entirely of wooden parts. The small mahogany cabinet is insulated by porcelain supports and is connected to the positive terminal of the lighting mains. A wooden contact-arm leans against the right-hand side of the cabinet and is held in this position as long as the current continues to flow. If the cabinet is touched in any manner or the supply leads are broken, the wooden arm will topple over and close a set of contacts, giving an alarm.

Through experimental work, it has been found that these relays can be actuated by means of the precipitation of moisture, by the ionization of the air or by the proper application of some suitable electro-magnetic counter-effect. Thus the scope of the work is widened and many fields of application are opened to these new relays.

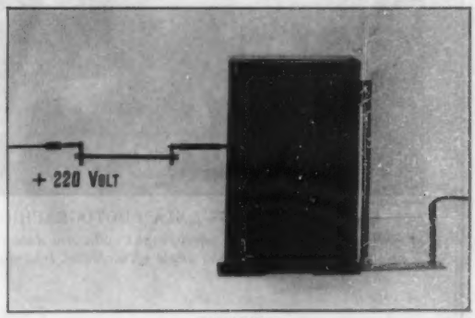


FIGURE 7

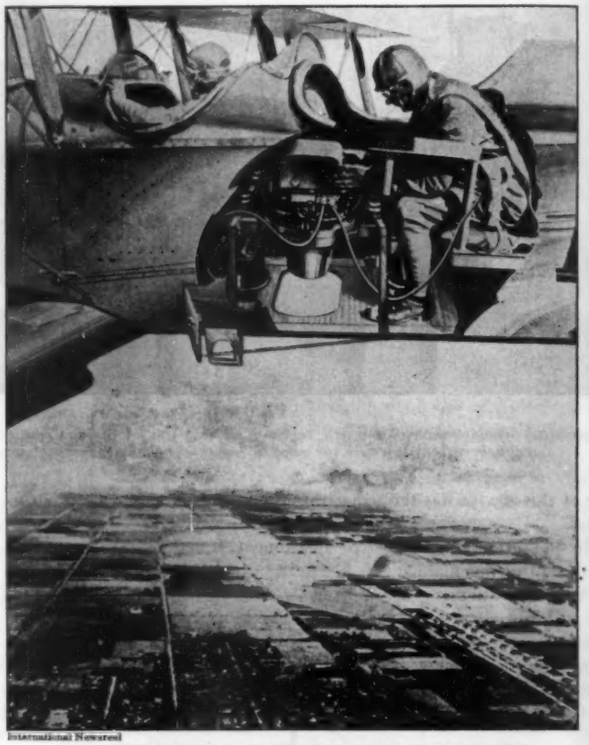
The wood strip at the right is supported solely by the adhesive force set up by the passage of current

Relays of the type described are particularly suited to application to burglar and theft alarms, especially since there are no complicated electrical conductors in the ordinary sense of the word. Any articles of wood, paper, clothing or other semi-conductor of electricity may be placed in the circuit, and if they be so much as touched, the alarm will be sounded. Articles laid out on a counter may be fully protected by this method, and there is the added advantage that no complicated, or for that matter, any apparatus need be exposed to the view of an intruder.

International Newsreel

GIANT CAMERA TAKES PICTURES FROM FIVE MILES UP

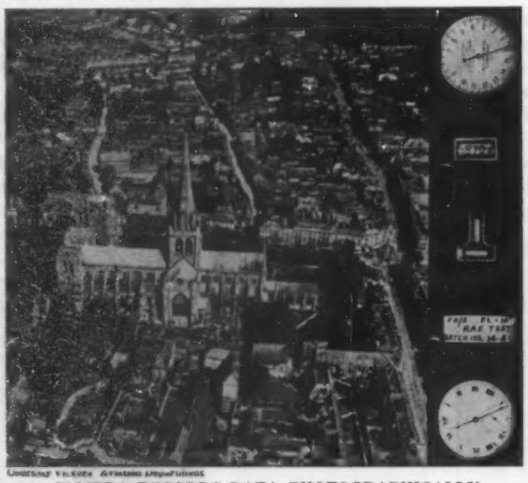
The United States Army Air Service has recently been using an unusually large airplane camera for photographing the earth from high altitudes. This camera has a nine-inch lens



International Newsreel

HOW THE BIRD-MAN USES THE AIRPLANE CAMERA

The camera is almost automatic. The film moves forward at predetermined intervals and at the right moment the exposure is made automatically



Courtesy Vickers Aviation Department

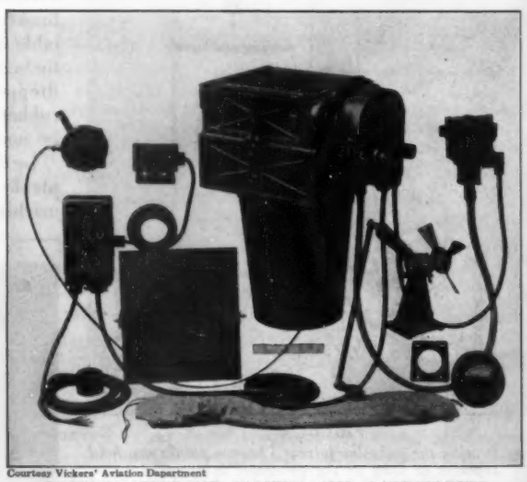
CAMERA RECORDS DATA PHOTOGRAPHICALLY

A British camera actually photographs collateral data on each film —altitude, exposure number, angle of airplane, lens data and time

P. & A.

IMMENSE FILM SPOOLS

Each spool holds 65 feet of film— enough for 100 exposures



Courtesy Vickers' Aviation Department

BRITISH AIRPLANE CAMERA AND ACCESSORIES

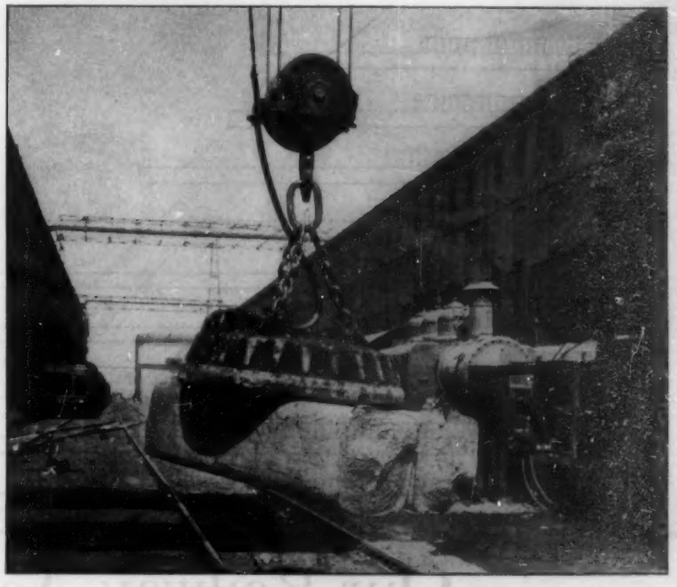
The camera, whose action is controlled from a small switchboard, is driven either by an electric motor, air propeller or by hand

Airplane "Eyes" Used for Map Making

Since the World War, and especially within the past two or three years, airplane photography and airplane mapping have been developed to a remarkable degree. It is now possible to make accurate maps by means of pictures taken obliquely from an airplane, and large areas have already been mapped in this manner. It is obvious, of course, that the simplest kind of photographic mapping would be accomplished by taking a "straight-down" picture from an airplane. When sufficient altitude is maintained and when the demands for accuracy are not too exacting, such pictures, pieced together in a mosaic, suffice fairly well. Another type of mapping is the stereographic, in which pictures taken obliquely are converted into maps. Here the technique becomes a little more complicated, and the services of the geometrician are required. Several methods have been developed, although they all have certain elementary principles in common. Interesting scientific facts are involved in the high-altitude pictures mentioned above. It has been found that even on days when the earth is partly veiled in haze, excellent pictures can be taken with films hypersensitized to the vibrations of the red end of the visible spectrum. This simply means that a way has been found to take advantage of these longer and more penetrating red rays—those which we see at sunset—and some of the infra-red. These do not affect ordinary photographic film.

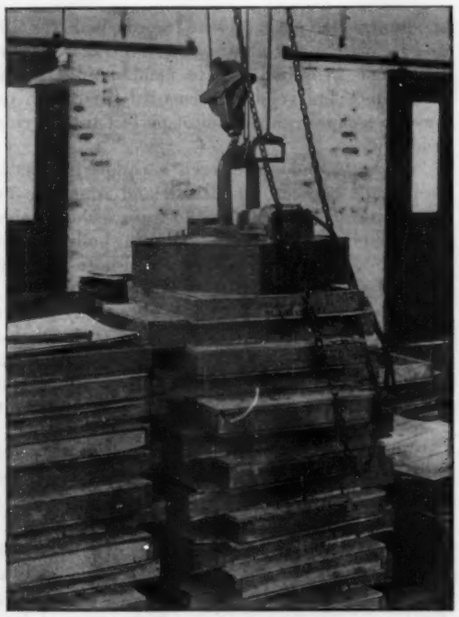
HANDLING STEEL RAILS

A 43-inch lifting magnet is suspended from a crane by means of cables. The current is furnished to the windings through large yet flexible insulated wires



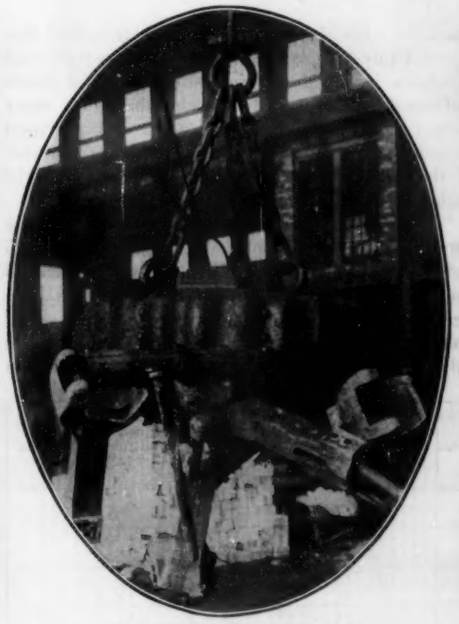
TWO FIVE-TON INGOTS AT ONCE!

This magnet is in continual use in a Pennsylvania steel mill. Used for the handling of large ingots, it expedites various operations to a great extent



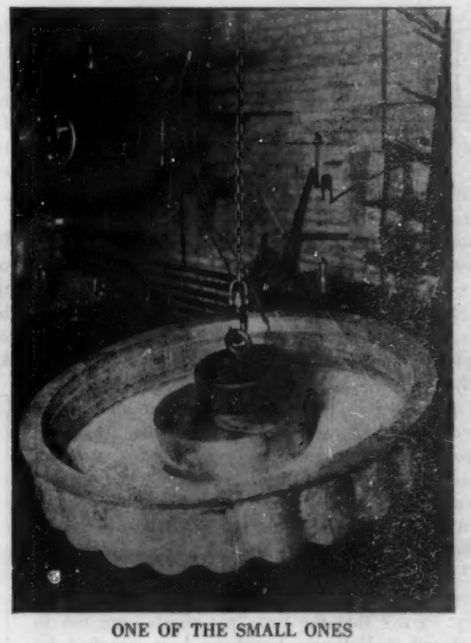
LIFTING BOXES AND ALL

Steel sheets already packed in boxes for shipping are easily moved from place to place with this magnet



CLEANING UP THE SCRAPS

A five-ton magnet of this type will readily clear the floor of debris that would be difficult to handle otherwise

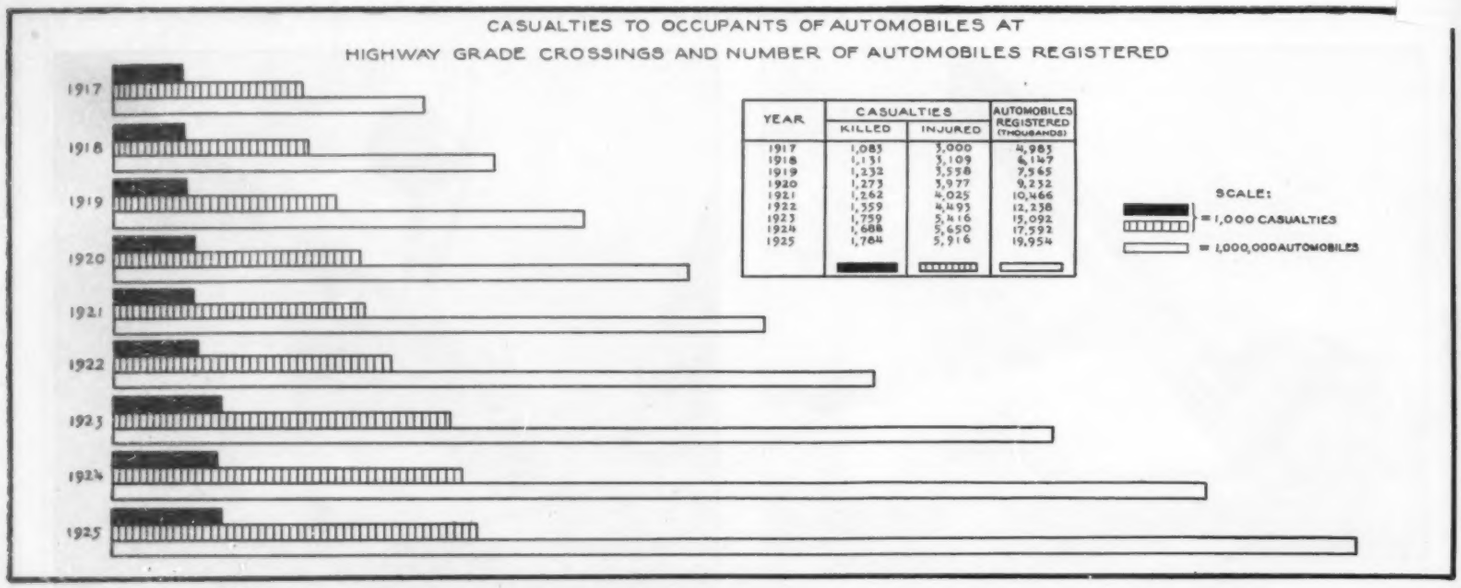


ONE OF THE SMALL ONES

The little 12-inch magnet is shown making easy work of lifting and carrying the shell of a larger magnet

Huge Lifting Magnets in Industry

Magnetism, that mysterious force which so intrigues the small boy and which furnishes the basis for many interesting experiments, has found a place in industry where its simplest manifestation is put to work with worth-while results. The phase of the activity of magnetism which is used here is its ability to lift and hold masses of iron or steel. In order to make the operations flexible and applicable to many different uses, that form known as electro-magnetism is employed. By doing this, the magnet can be energized or de-energized at will, thereby allowing it to be used to lift or release masses of metals at the desire of the operator of the switch in the electrical circuit. The various photographs on this page illustrate several uses of large electro-magnets in steel mills and railroad yards. In each case, note the flexible cables which conduct the electricity to the windings of the magnet. It is claimed that the proper size of lifting magnet will replace from two to five men when properly handled and will therefore release these employees for other more important work than the mere transportation of materials about the shop. A word-sketch of the interior of one of these magnets is interesting. The outer shell or body is made of high permeability steel. This machined casting protects the winding which furnishes the magnetic field. The coils for the larger types of magnets are wound with strap copper, insulated by means of asbestos ribbon. Mica placed between the layers prevents short-circuiting. This high-grade insulating material is placed also between the coil and the steel bobbin on which the conducting strap is wound. The bobbin, being made of steel, becomes part of the magnetic circuit and because of this, it is said that the amount of metal in the magnet frame can be reduced. The entire assembly is clamped tightly together and dowel pins placed at strategic points prevent the shifting of the coil when in use. The completed magnets are handled by means of various types of cranes.



YEAR	CASUALTIES KILLED	CASUALTIES INJURED	AUTOMOBILES REGISTERED (THOUSANDS)
1917	1,083	3,000	4,985
1918	1,131	3,109	6,147
1919	1,232	3,558	7,565
1920	1,273	3,977	9,232
1921	1,262	4,025	10,466
1922	1,359	4,493	12,238
1923	1,759	5,416	15,092
1924	1,688	5,650	17,592
1925	1,784	5,916	19,954

Our Railway Accidents Analyzed

Increase in Safety Is Due to Extreme Care

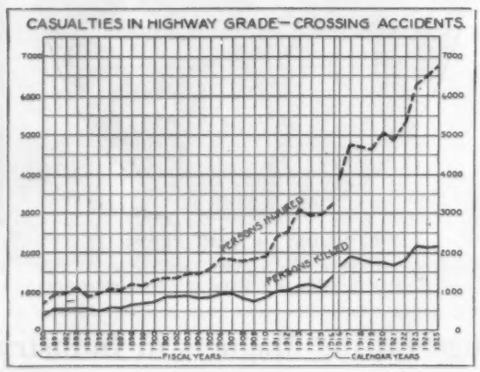
EACH year the Interstate Commerce Commission issues a bulletin of some one hundred and sixteen pages devoted to steam-railroad accidents. Statistics may not be interesting reading, but they are very illuminating when dressed up in proper clothing. This Accident Bulletin Number 94 is for the calendar year 1925 and is the work of Dr. M. O. Lorenz, the distinguished Director of the Bureau of Statistics of the Interstate Commerce Commission. So complete is the information presented that when the committee, which awards the Harriman Memorial Medals for the best record of steam railroads of various classes, met, it was only necessary to develop methods of weighing the merits.

The gold medal, sponsored by Mrs. Harriman and presented in memory of her great husband, a railroad seer, is awarded through the American Museum of Safety and has been won for two successive years by the Union Pacific System for their noteworthy achievement of operating a railroad practically without accidents. The silver and bronze medals went to roads of smaller size.

The diagrams are so lucid that we shall not attempt to give an extensive description of them except to say that the two "pie charts" are not in the Accident Bulletin, but have been checked by Dr. Lorenz. Two definitions should be given so as to differentiate "train accidents" and "train service accidents." By "train accidents" we are to understand accidents with or without casualties arising in connection with the operation or movement of trains, locomotives or cars that result in damage to equipment or other railway property in excess of 150 dollars (including cost of clearing the wreck). Such accidents include collisions, derailments, locomotive boiler accidents and other locomotive and miscellaneous accidents. For "train service accidents" the official definition is: accidents arising in connection with the operation or movement of trains, locomotives or cars that result in reportable casualties to persons but not in damage to equipment or other railway property in excess of 150 dollars (including cost of clearing wreck).

The writer happens to be an ex-officio member of the Committee of Award of the Harriman Medals and, sitting next to Dr. Julius H. Parmelee at the luncheon when the award was made, remarked that it was a pity that the newspapers compared railroad accidents in Great Britain and the United States unfavorably to us. Dr. Parmelee then gave many facts controverting these statements and promised to contribute to this article. Dr. Parmelee, Director of the Bureau of Railway Economics and a world authority on railways, says:

"Considerable newspaper publicity has recently been given to a statement that during the year 1925 only one passenger was killed in a train accident on the railways of Great Britain. This fact has been held out as a remarkable achievement, and as a sad commentary on the larger number of passengers killed in train accidents during the same year on



the railways of the United States. The achievement of the British railways in 1925 in this particular respect was a notable one, and there is no desire on my part to belittle it in the slightest.

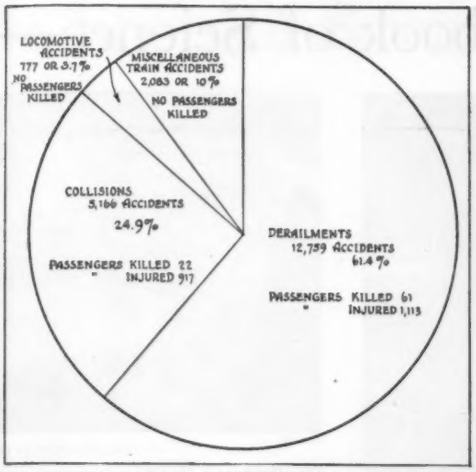
"In the first place, it happens that the year 1925 was unusual, from the safety point of view, in British railway annals. In the previous year, for example, twenty-four passengers were killed in train accidents on the British railways, while during the present year a number of accidents have already occurred in which passengers were killed. For example, there was a serious train wreck on the London, Midland and Scottish Railway, which occurred near Rotherham, on November 19th, last, which resulted in killing nine passengers outright. It appears that the accident records both for 1924 and 1926 were much worse than for 1925, that year being one in which a rare combination of good railroading and good luck enabled the British railways to escape with an almost perfect train accident record.

"In the second place, such a comparison as has been made between the British and American railways should not be confined to train accidents alone. Passengers are killed annually in both countries because of the operation of trains, whose deaths are not technically attributed to 'train accidents.' In addition to train accidents, there are many accidents in connection with the movement of trains that are known in the United States as 'train service accidents,' and in Great Britain as 'movement accidents,' these two types of accidents being practically the same.

"When this class of accident is included in the comparison, it appears that in Great Britain a total of 71 passengers were killed in train and train service accidents in 1925, compared with a total of 175 passengers who similarly lost their lives on the railways of the United States during the same year. These totals do not include a number of passenger fatalities in both countries, which occurred in so-called 'non-movement accidents.'

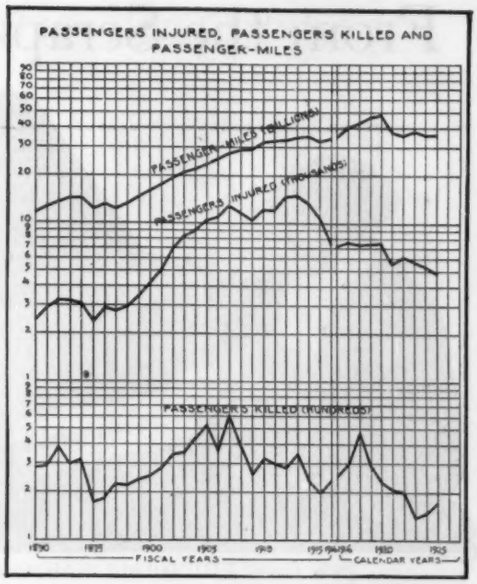
"It must be remembered that the railways of Great Britain operated in 1925 a little over 20,000 miles of line, compared with approximately 250,000 miles of line in the United States. On the basis of mileage alone, which is more than 12 times as great in the United States as in Great Britain, the fact that the number of passenger fatalities in this country were only two and one-half times as large as in Great Britain would indicate a situation much more favorable to the United States than the stark figures disclose.

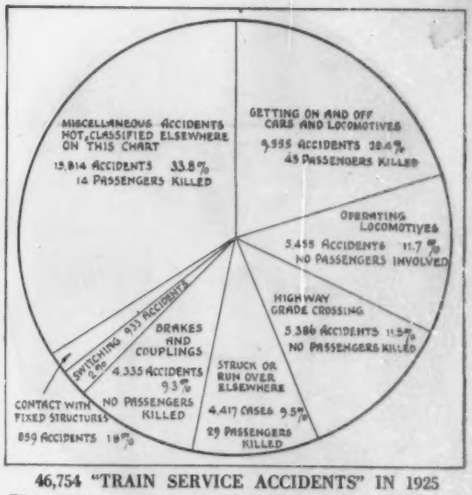
"Perhaps the fairest method is to place the comparison on a basis of passenger miles, namely, the figure equivalent to the total number of passengers carried one mile in each country. On this basis, it appears that in 1925 one passenger was killed in train and train service accidents in Great Britain for every 276,700,000 passenger-miles, whereas in the United States one passenger was killed for every 205,500,000 passenger miles."


LOCOMOTIVE ACCIDENTS 777 OR 3.7% NO PASSENGERS KILLED
MISCELLANEOUS TRAIN ACCIDENTS 2,083 OR 10% NO PASSENGERS KILLED
COLLISIONS 5,166 ACCIDENTS 24.9%
PASSENGERS KILLED 22 INJURED 917
DERAILMENTS 12,759 ACCIDENTS 61.4%
PASSENGERS KILLED 61 INJURED 1,113

20,785 "TRAIN ACCIDENTS" IN 1925

In the text will be found the official definition of accidents of this type which includes collisions, derailments and other accidents which are of vital interest to the public

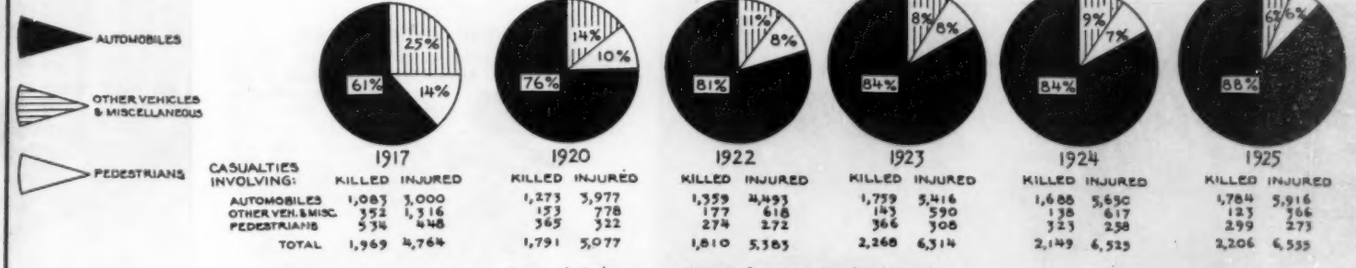



MISCELLANEOUS ACCIDENTS NOT CLASSIFIED ELSEWHERE ON THIS CHART 15,814 ACCIDENTS 33.8% 14 PASSENGERS KILLED
GETTING ON AND OFF CARS AND LOCOMOTIVES 9,935 ACCIDENTS 20.4% 45 PASSENGERS KILLED
OPERATING LOCOMOTIVES 5,455 ACCIDENTS 11.7% NO PASSENGERS INVOLVED
HIGHWAY GRADE CROSSING 5,386 ACCIDENTS 11.5% NO PASSENGERS KILLED
STRUCK OR RUN OVER ELSEWHERE 4,417 CASES 9.5% 29 PASSENGERS KILLED
BRAKES AND COUPLINGS 4,335 ACCIDENTS 9.3% NO PASSENGERS KILLED
SWITCHING 933 ACCIDENTS 2%
CONTACT WITH FIXED STRUCTURES 859 ACCIDENTS 1.8%

46,754 "TRAIN SERVICE ACCIDENTS" IN 1925

These accidents are noted on the chart and a full official definition of such accidents will be found in the text. "Watch your step" is the obvious moral of this chart

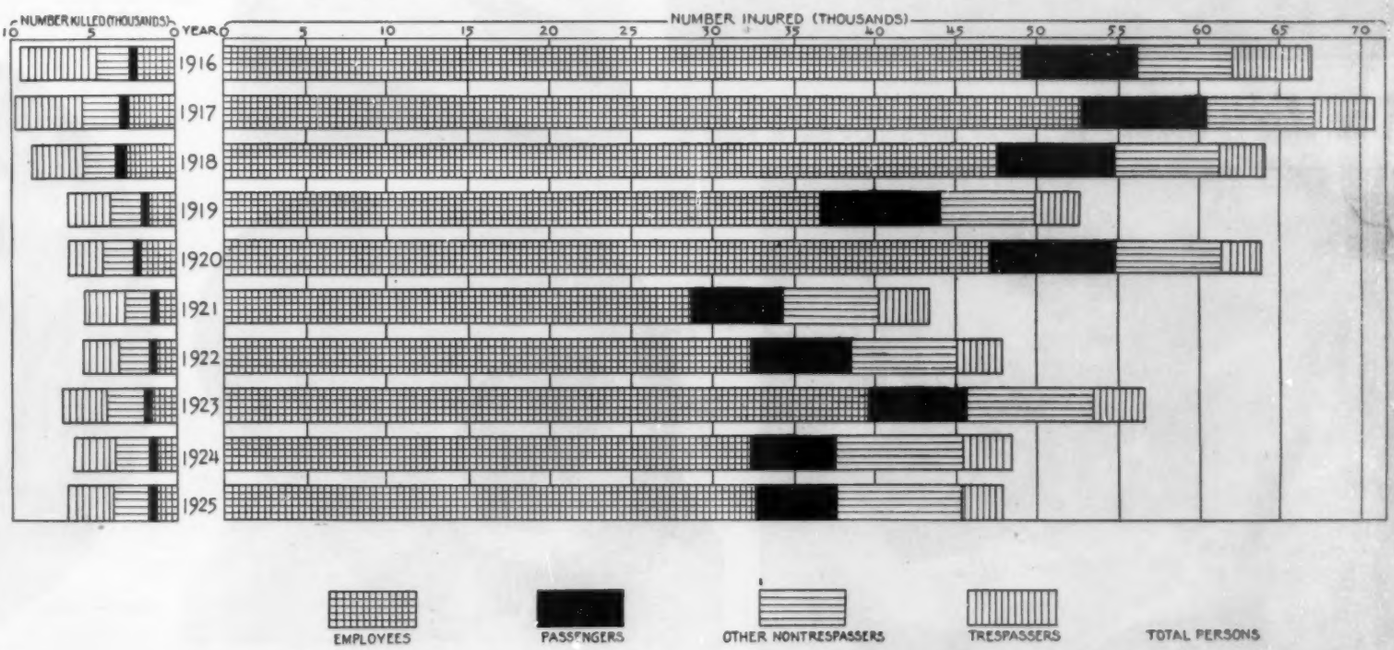
DISTRIBUTION OF CASUALTIES AT HIGHWAY GRADE CROSSINGS



CASUALTIES INVOLVING:	1917 KILLED	1917 INJURED	1920 KILLED	1920 INJURED	1922 KILLED	1922 INJURED	1923 KILLED	1923 INJURED	1924 KILLED	1924 INJURED	1925 KILLED	1925 INJURED
AUTOMOBILES	1,083	3,000	1,273	3,977	1,359	4,493	1,759	5,416	1,688	5,650	1,784	5,916
OTHER VEH. & MISC.	352	1,316	153	778	177	618	143	590	138	617	123	366
PEDESTRIANS	534	448	365	322	274	272	366	308	323	258	299	273
TOTAL	1,969	4,764	1,791	5,077	1,810	5,383	2,268	6,314	2,149	6,525	2,206	6,555

Areas of circles represent totals of persons killed and injured.

CASUALTIES TO PERSONS IN TRAIN AND TRAIN-SERVICE ACCIDENTS



EMPLOYEES		PASSENGERS		OTHER NON-TRESPASSERS		TRESPASSERS		TOTAL PERSONS	
Year 1916—Killed	2,513	Year 1916—Killed	246	Year 1916—Killed	1,789	Year 1916—Killed	4,928	Year 1916—Killed	9,476
Year 1916—Injured	49,121	Year 1916—Injured	7,152	Year 1916—Injured	5,916	Year 1916—Injured	4,793	Year 1916—Injured	66,982
Year 1925—Killed	1,299	Year 1925—Killed	171	Year 1925—Killed	2,310	Year 1925—Killed	2,584	Year 1925—Killed	6,364
Year 1925—Injured	32,484	Year 1925—Injured	4,952	Year 1925—Injured	7,869	Year 1925—Injured	2,688	Year 1925—Injured	47,993

From the Scrap-book of Science—Came

Wide World

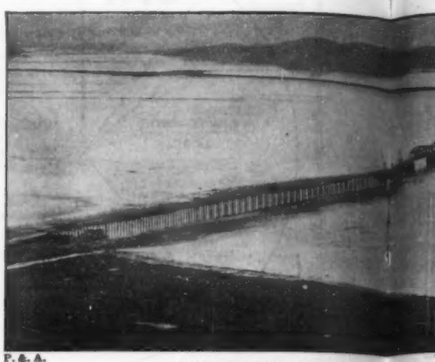
"FANNY," THE ELECTRIC COW

In order to provide passengers on ocean liners with milk, the electric cow must be resorted to. This machine produces milk from milk powder, unsalted butter and water. The device is installed on the S.S. Asturias

Wide World

NEW PIANO WITH DOUBLE KEYBOARD

Emanuai Moor, the English composer, has invented a piano whose upper keyboard has a register one octave higher than the lower. It can be coupled to play with the lower. This overcomes certain technical difficulties for pianists: octave runs can be played with single fingers, tenths as thirds, and so forth



P. & A.

SAN FRANCISCO'S FIRST EASTBA

The Dumbarton Bridge, just opened, forms San Francisco's Francisco Bay. The total length is 6,305 feet, made up of 2 lift span, which permits vessels to pass through. The total

International Newsreel

THREE-WHEELED MOTOR CAR

This car has a tread of 36 inches and a wheelbase of 96 inches. It is powered with a two-cylinder motor which, it is claimed, drives the car 40 miles per gallon of gasoline. A maximum speed of 80 miles per hour has been attained. The owner and driver is Mrs. William M. Wright

SEA-GOING MOVIE CAMERA

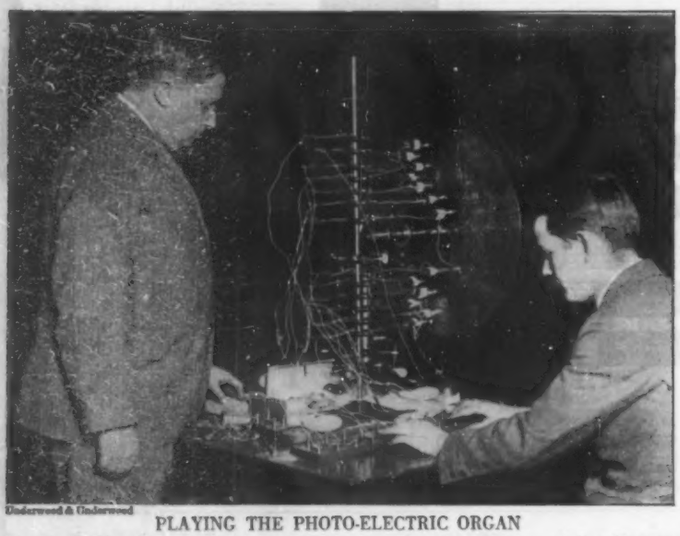
When a moving picture is taken from the deck of a rolling ship, the motion of the ship shows in the film when later presented to the audience. Here is a camera which is attached to a pendulum and hung on a swiveling device. This keeps the camera level

P. & A.

Photo by R. Sennecke

PUTTING WHEELS UNDER

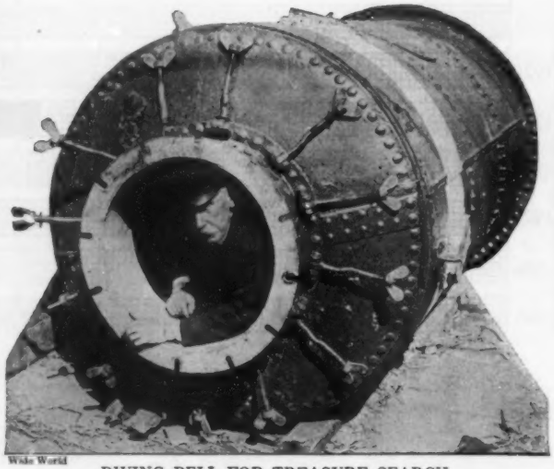
In many countries there are several track gages in reloading necessary at points of junction betwee systems. To obviate this expensive procedure, th placed on a pair of trucks of different gage. Th many." In Australia, for example, there ar



Underwood & Underwood

PLAYING THE PHOTO-ELECTRIC ORGAN

Dr. E. E. Free, former editor of the Scientific American (left) and Dr. Norman Hilberry (right) of New York University, demonstrating an interesting scientific apparatus which illustrates properties of the photo-electric cell. Rays of light from small electric lamps pass through holes in a rotating disk and enter a photo-electric cell which reconverts the light into electric impulses. These are transformed into sound



Wide World

DIVING BELL FOR TREASURE SEARCH

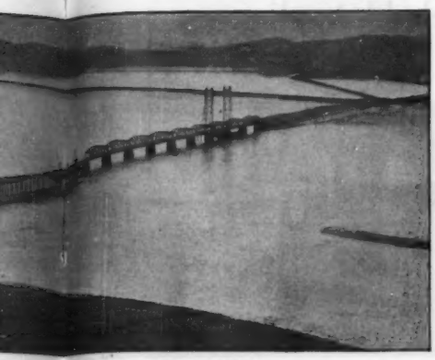
Lieutenant-Colonel K. M. Foss of England has designed a diving bell in which he intends to go down and direct the operations of divers at work on a treasure ship of the Spanish Armada, sunk near Great Britain. The diving bell weighs three tons and is equipped with heavy glass portholes through which the work of recovering the gold may be watched and intelligently directed

International Newsreel

LIQUID FUEL FROM C

This is a small working model of a retort are being carried out in England with th bonization of coal. Coal contains carbon, hydrogen. From these elements innume many of great value, can be made by the ch low-temperature carbonization

-Camera Shots of Scientific Happenings

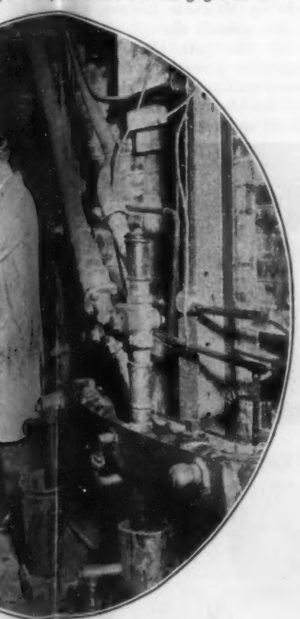


'S FIRST EASTBAY CONNECTION

ns San Francisco's first connection with Eastbay across San feet, made up of 226-foot spans. Near the center there is a through. The total cost was more than two million dollars

WHEELS UNDER WHEELS

everal track gages in widespread use. This makes of junction between any two of the respective pensive procedure, the car may be elevated and different gage. This device was "made in Ger- for example, there are several gages in use



ID FUEL FROM COAL

g model of a retort in which experiments in England with the low-temperature car- oal contains carbon, oxygen, nitrogen and se elements innumerable recombinations, n be made by the chemist by means of the erature carbonization process

P. & A.

HATH MUSIC CHARMS?

To minimize the mental shock of an operation recently performed at St. Mark's Hospital in New York, without ether, radio music was listened to by the patient, who stated that it enabled her to keep her mind off the operation. A local anesthetic was used, but there is usually some shock under these circumstances

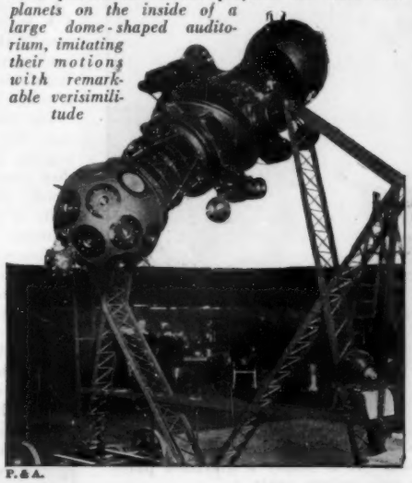
Wide World

ULTRA-VIOLET LIGHT FILTER

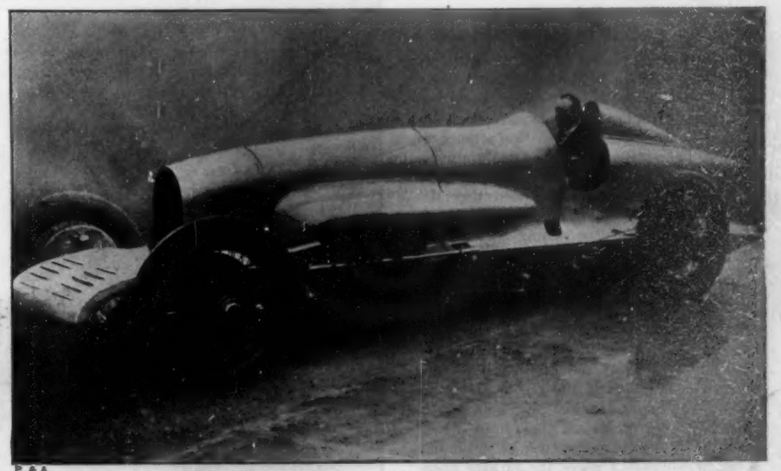
Dr. W. W. Coblenz of the United States Bureau of Standards, with a screen of cerium-oxide glass. When placed in front of the large studio arc-lamps it protects the eyes of the actors from the harmful effects of ultra-violet light

NEW PLANETARIUM FOR BERLIN

This is the projecting apparatus for the remarkable Zeiss planetarium which projects the stars and planets on the inside of a large dome-shaped auditorium, imitating their motions with remarkable verisimilitude



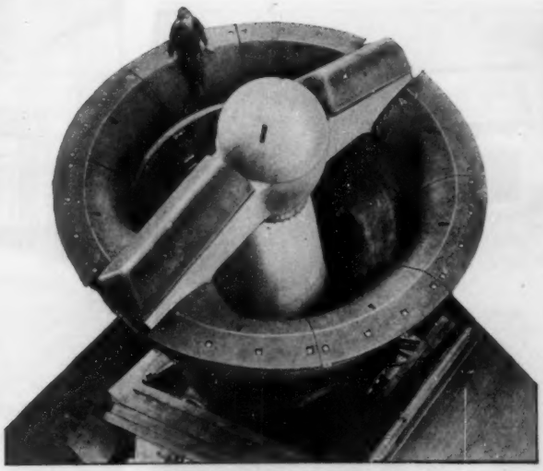
P. & A.



P. & A.

174.883 MILES PER HOUR—WORLD'S RECORD

With this car, driven by a 500-horsepower motor running at 2,200 revolutions per minute, Captain Malcolm Campbell recently broke the world's record for a mile from a flying start. The same engine could drive a bombing plane at a speed of 232 miles an hour. The car cost 40,000 dollars and required two years work to make. Captain Campbell was an aviator during the World War



MILLION-POUND ORE CRUSHER

The Allis Chalmers Company has just built for a Chilean mine two ore crushers into which 70-ton carloads of ore may be dumped. The copper ore to be crushed is very hard, and comes in pieces weighing several tons. Two thousand tons is the hourly capacity. Each crusher required 12 freight cars for shipment to the seaboard

International Newsreel

HE TRANSPLANTS EYES

Transplanting eyes, legs and spinal cords is everyday work for Dr. H. L. Wieman, zoologist, of the University of Cincinnati shown above at right. He works with salamanders (left). He has transplanted an eye from one salamander to the place where he has removed the leg of another. There the eye functions normally. This experiment succeeds best with lower forms of life, the salamander being an amphibian

Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

Conducted by Albert A. Hopkins

A power screw-driver

Electrically Driven Tools

THE tools shown at the top of this page are driven by an electric motor through the medium of a flexible shaft. They are sufficiently light to be manipulated with one hand. Being of small diameter, they are useful for working in corners and inaccessible positions and can be used at any angle. These tools, of English manufacture, have been found of great value in driving or extracting screws and doing other light work.

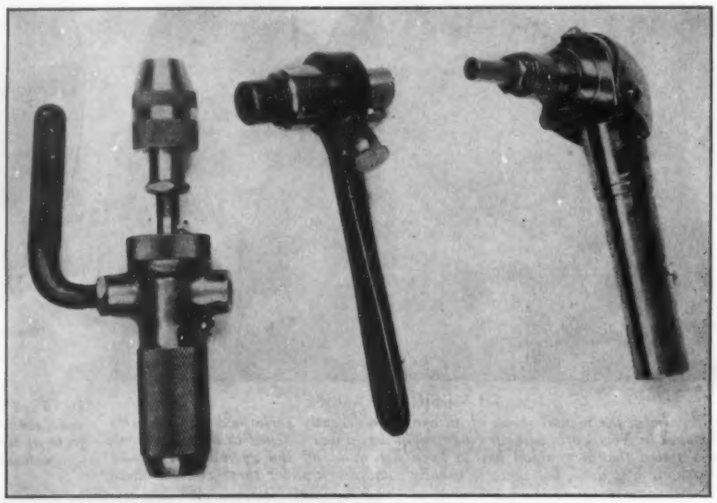
Water-cooled Furnace Screen

CHAIN screens, made by a Baltimore concern, have found useful application in the boiler rooms of many industrial plants. Their purpose, when suspended before a furnace opening is to "keep the heat in and the cold out." The semi-transparency of the chain permits a view of the interior, at the same time protecting the furnace tenders from heat, glare and flying sparks and the furnace charge from drafts. The flexibility of these chain screens prevents interference with the use of tools or handling of the charge.

Where flames do not impinge on the chains of ordinary screens, the radiant heat from the hottest furnace will not bring the screen to even a dull redness; where a blast drives the fire against the chains they will glow. To overcome this, the new water-cooled screen illustrated has been developed. The system makes use of a tubular reservoir, supported above the furnace opening, in the bottom of which is a slot. This slot is immediately over the suspended screen.

The water enters the tubular reservoir through a regulating valve. A small quantity of water is fed through the slot to each strand of chain which becomes covered with a film of water. This trickles down and is usually evaporated before the end of the chain is reached. Because of the cooling effect of the water, a furnace door of unusually low temperature is afforded.

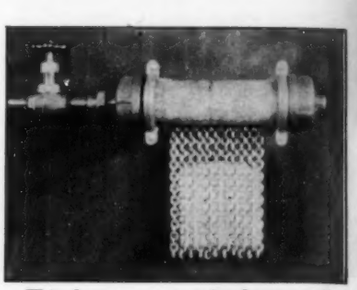
An electric miner's lamp



Power-driven hand tools of English manufacture

Interior of a German barber shop for children. It is really a glorified playroom where they choose their own unique seats

A pavement that combines the good qualities of wood and rubber



This furnace screen is always cool

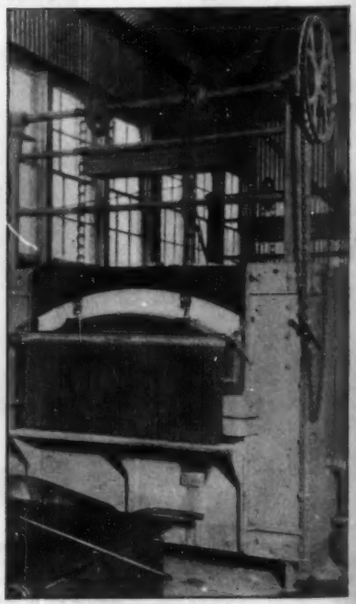
More Light for the Miner

THE lamp illustrated contains two bulbs of different powers. The reflector is attached to the cap by a rigid bracket. The emergency bulb can be switched on if the regular bulb fails, thus eliminating the necessity of changing lamps in the dark. The battery carried on the belt will supply current to the lamp for twelve hours.

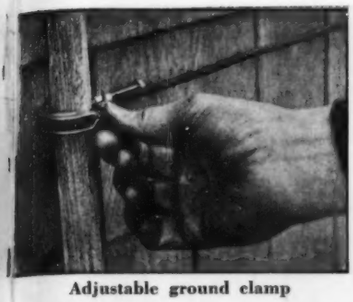
A Non-skid Road

AN English inventor has devised a composite paving block which has, in the case of the trial strip laid in London, England, proved itself impervious to water. With this surface, it is said that skidding is practically impossible.

The block consists of the standard wooden type duly creosoted, with a truncated triangular groove cut in it. The block is then coated with a special rubber solution which, while not interfering with the elasticity of the wood, closes the pores of the material. Then specially prepared rubber, perforated through the center to give it a silent and resilient quality, is inserted in the groove. This has a "crown" above the surface of the wood face. The rubber is fitted in the blocks in alternate manner, one block having its groove through its central length, while the next block is grooved twice diagonally across its face. This method ensures a continuous and even-bearing face. When the blocks are laid, the paving has a tesselated appearance.



Large screen covering furnace door



Adjustable ground clamp

Readily Attached Ground Clamp

THE new ground clamp shown on this page is pressed from heavy sheet-iron and spot welded. Its shape and make-up afford a tight grip upon the pipe used for a ground connection. A brass bolt is provided for fastening the wire. The end of the attaching screw is pointed and presses directly into the pipe, thus avoiding the necessity of scraping the latter to make good contact.

Winter Motorcycle Sport

THE police department of Montreal has adopted a snow motorcycle which is giving good satisfaction. Large numbers of private individuals also use them. An iron-pipe frame serves to unite the sleds and the motorcycle as shown. A tire chain attached to the rear wheel gives the necessary traction. The steering is done with a wheel which actuates the front set of runners.

Homemade Scrap Containers

AT a western steel shop, where a great deal of repair work is done, it is always necessary to take care of a considerable amount of scrap metal. For the sake of neatness and efficiency in handling this metal, it is sorted and stored in metal baskets. The baskets are made from the fireboxes of old locomotive boilers. Two large hooks are riveted at each end, one near the top, the other in the middle of the bottom.

Automatic Dough-mixer and Distributor

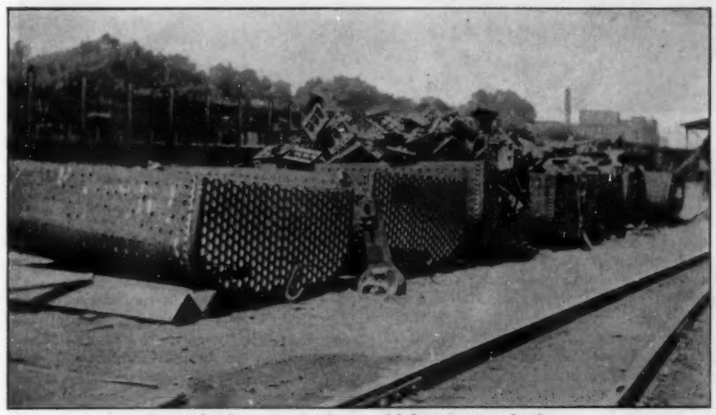
THE batter mixer shown on this page consists of an aluminum container for the ingredients and a mixer driven by an electric motor. The mixer is supported on a movable arm with elbow-joints, making it easy to move the bowl over any desired part of the table or griddle. A valve at the bottom of the container controls the flow of the mixture.

A Shear with Rotary Cutters

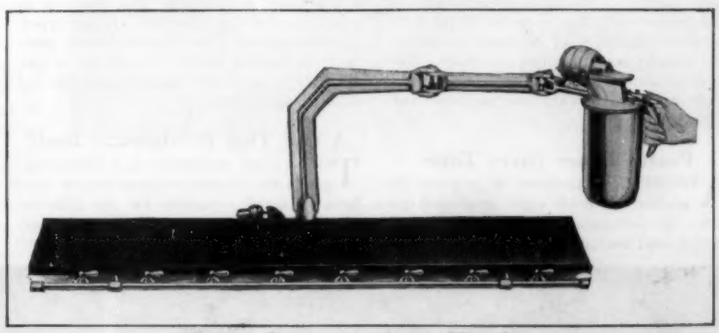
THE hand shear shown in the lower left-hand illustration, quickly cuts corugated sheet-metal up to 20-gage in thickness, either straight, on a curve, or obliquely. Very little power is required to operate this tool. It is self-feeding and once the cut is started, the movement of the shear is quite automatic. The cutting is done by two rotary double-edged disks, the upper being driven by an internal ratchet, which is operated by the handle, while the lower one runs free. A cap screw adjusts the cutter, and by loosening this, the shear may be removed from the sheet, thus permitting the cutting of angles and corners.

Heavy-duty hand shear

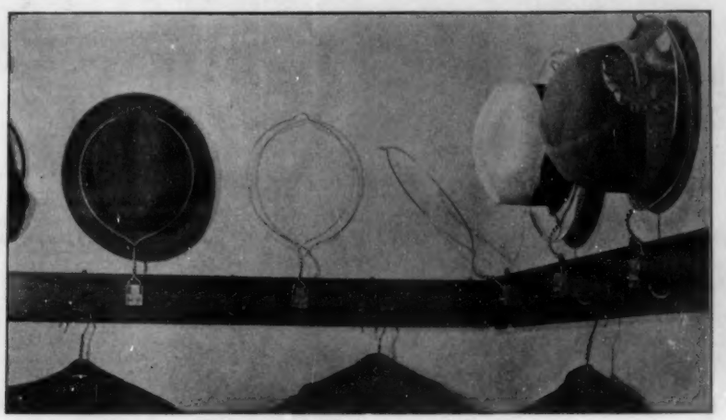
Motorcycle sleigh uses wheel with chain for traction



Scrap baskets made from old locomotive boilers



Sanitary batter-mixer for griddle-cakes



This system holds hats out of the way

Rubber dog biscuit

Fun for the Dog

RUBBER dog-biscuits and bones for the family pup to play with are among the latest novelties from London. These devices are so fabricated that, even when submitted to rough usage, the material will not shred or break. Thus there is no danger of the dog getting small particles of the rubber caught in his throat.

Hat Holder

IN the center illustration at the bottom of this page is shown a recently patented hat rack which serves to keep hats out of the way. It consists of a hinged loop adapted to receive the hat and hold it against the wall. This loop exerts just enough pressure to keep the hat in place, yet not enough to crush it.

Quick and Accurate Spring Winder

THE spring winder shown in the lower right-hand photograph will make perfect springs of any desired diameter. It will handle material from the finest piano-wire up to 3/16-inch stock. The winder has a supply of mandrels so that coils can be wound ranging from one-sixteenth to one inch in diameter. To wind a spring, the wire is threaded through a tension nut, thence in between the cam and side of the casting, then over or under a mandrel to make a left or right-hand coil as desired, and is finally attached to the tension nut on the handle. The tension nut on the front of the winder is then tightened enough to make the wire taut.

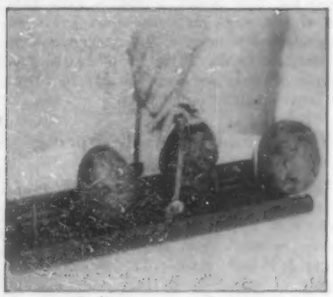
The coil spring is made by turning the handle of the winder. The diameter of the coil is determined by the size of the mandrel used, while the pitch or lead is regulated by the position of the cam.

Hand-operated spring winder

The "step stool" in use

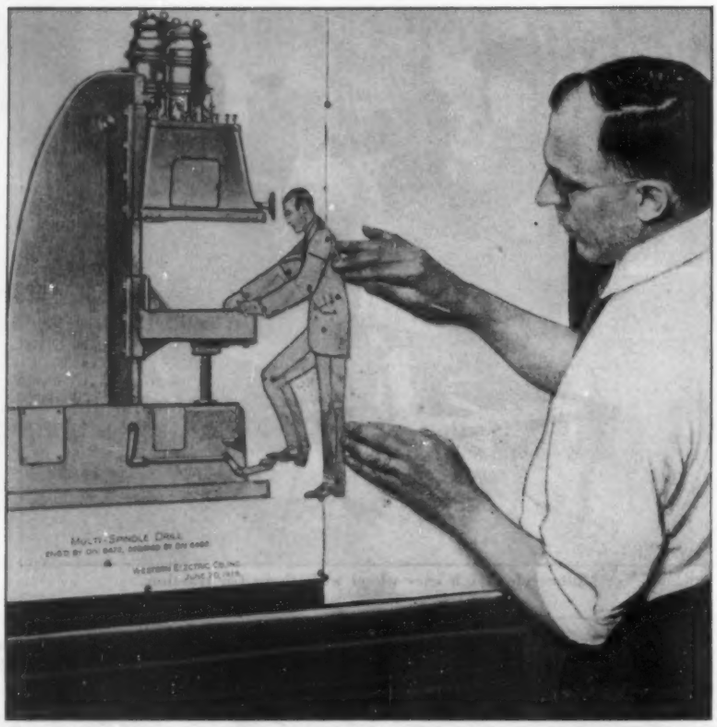
Stool of Many Purposes

WE are apt to consider stools only as kitchen stools or bathroom stools, but in reality there is hardly a room in the house where a really dependable stool will not prove useful. However, accident statistics show that chairs, ladders and ordinary stools are a very fertile source of trouble. The stool which we illustrate at the top of this page should eliminate many accidents. It is built of cold-rolled angle steel and is



Folding potato baker

necessarily safer than wooden stools where the screws are apt to come out or shear off. It is of the right height to slip under a sink or kitchen table. Flat feet protect the floor. The disappearing step enables anyone to mount and descend the stool safely and gives a feeling of confidence that is essential when one is elevated above the floor level.



Determining by means of paper dolls whether or not the operator has sufficient room to work with ease

Tests for Efficiency and Comfort

IN the modern factory great attention is paid not only to comfort of the worker, but to his efficiency, and to the efficiency of the machines with which he works. Many devices are in use among shop-managers to help these plans along. One of the best we have ever seen is shown in the middle illustration at the top of this page. A cardboard manikin is used by the Western Electric Company in proportioning machine equipment so that working parts are convenient to the operator. In the present instance, the problem is to determine whether the operator has room to work with ease. The paper "doll" is comparable to the scale to which drawings of machine equipment are usually made by this company. The joints of the body are designed so that the figure can bend forward and backward correctly.

Potato Baker Saves Time

A FOLDING potato-baker is now on the market. It holds eight large-sized potatoes on triangular skewers. Thus, they receive heat uniformly on all sides, and as a consequence, the potatoes are baked in a manner that makes them more appetizing and "mealy."

Steams and Irons in One Operation

THE device shown in the middle of the right-hand column is a metal attachment for the spout of any tea kettle. When the kettle is partly filled with water and put over a gas or other flame, the steam will come out through the miniature ironing board. By passing materials to be pressed over this heated surface, very creditable results may be obtained. The device is so made that felt and straw hats can be shaped, wrinkles pressed from clothes, creases made in hems and so forth. The device is particularly adapted to pressing neckties and other small articles.

A Car That Refrigerates Itself

TO transport perishables and cold-storage products, electric refrigerator-cars have been designed especially for the Chicago, North Shore and Milwaukee Electric Railroad. These cars have interior fittings such

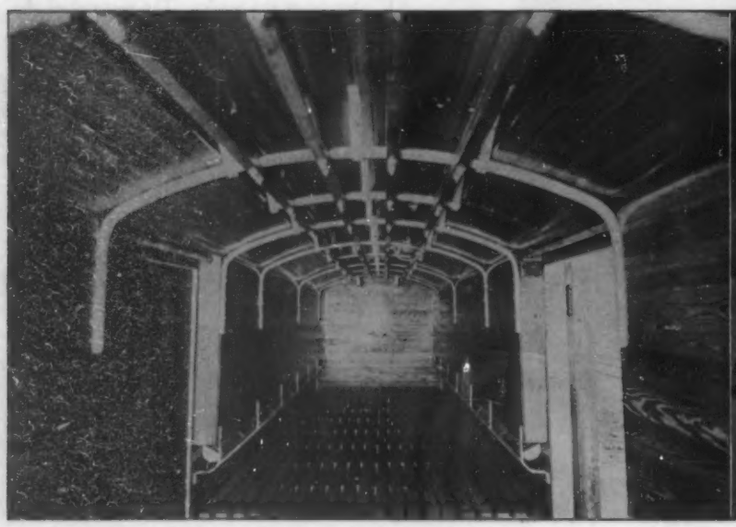
Working in Safety

as shown in our lower illustrations. They are equipped with an ammonia compressor, ammonia condenser and water-cooling apparatus. All of the machinery is operated by electricity. Thermostatic control is used to maintain an even temperature at all times, while the air-cooling apparatus for refrigeration is said to assure cleanliness and preservation of shipments in first-class condition. Cars can be left on sidings without danger that the shipments will suffer.

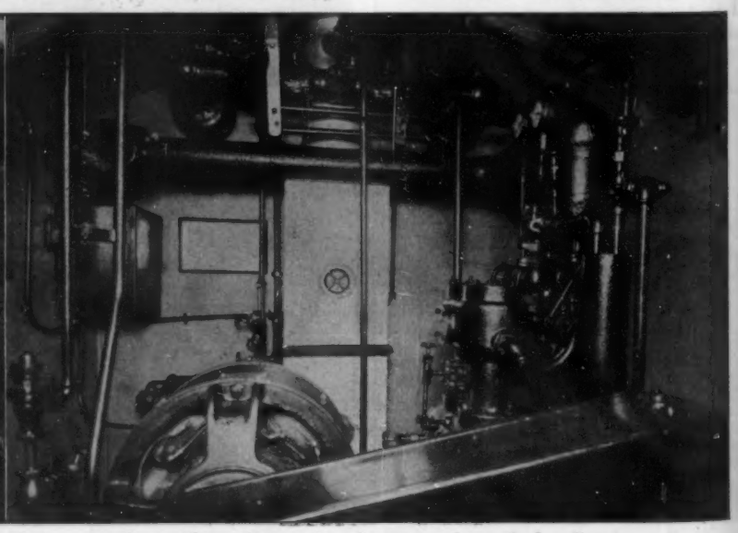
Tea kettle becomes tailor

Printing Ink from Sulphite Lye

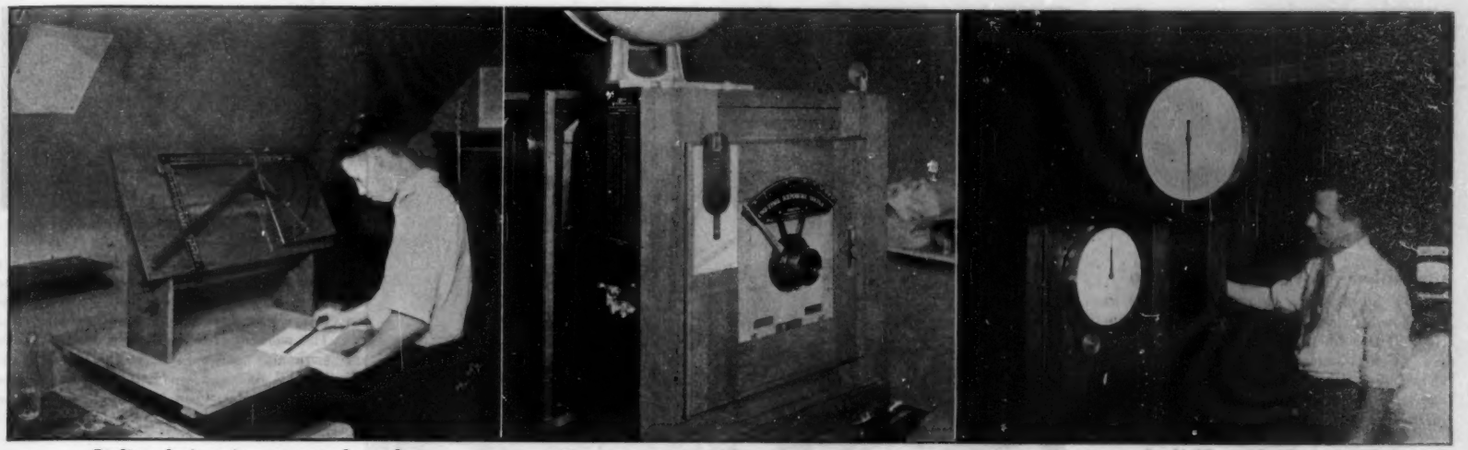
EXPERIMENTS have been carried on for a number of months in Sweden with a new method for producing printing ink from sulphite lye. It was invented by a Danish engineer, M. Ludvigson. The ink obtained by the system is said to be of as high quality and 20 percent cheaper in cost than that obtained by present methods.



Interior of the automatically refrigerated car



A complete refrigerating plant is at the end of each car



Scaling device gives a control number — Exposure meter gives correct exposure — Automatic focus finder uses the control number

Quenching the Travelers Thirst

THE novel and striking decorative beauty of the four new Pullman lounge cars built for operation over the Burlington's Chicago-Denver lines have to be seen to be appreciated. In the Pompeiian Lounge, cooling soft drinks are served from a real soda fountain in the steward's bar.

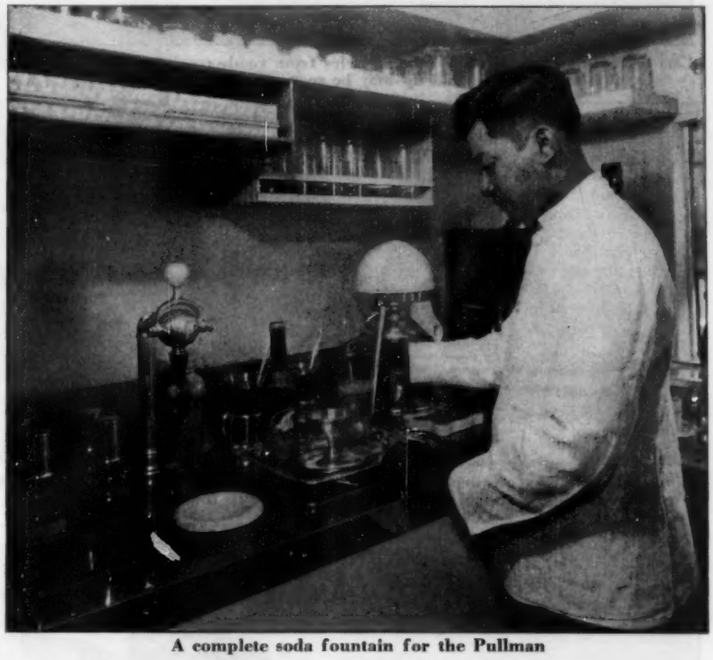
Hand-operated Stump Puller

THE stump-pulling device shown in the lower right-hand illustration is worked by hand power. The up-rooted stump shown on the left indicates its great pulling power. Two men pulled out this cedar stump in twenty minutes.

The invention of the "monkey winch" is really a romance of the Australian pioneer days. The manufacturer's grandfather went to Australia in the "roaring fifties" and dug up nuggets in the gold fields. But he decided that his boys should dig agricultural land instead, so they cleared a big farm in the old fashioned way with brute strength. One of the boys finally got tired of heavy manual labor and devised the original type of puller which the next generation improved upon. So in nearly all parts of the world, the "Australian monkey winch" is known.

Time Saver for Engravers

CONSIDERABLE time is lost in photo-engraving establishments in getting the focus, but with a newly invented series of devices, which work in cooperation, guesswork is avoided and the operations are standardized. The upper left-hand picture shows a scaling instrument which gives a control number for each copy, as well as the exact proportion of any copy in inches or type measurements. The use of this scaling device eliminates the time-destroying operation of focusing on a ground glass.



A complete soda fountain for the Pullman

The actual operation of focusing is shown in the illustration in the upper right-hand corner. One dial is mounted on the top and another on the side of the camera. These dials are made up for the particular lens with which they are to be used. The camera is moved so that the dial indicates the same as the control number on the copy, whereupon the focus is found to be correct.

The third device is shown in the center photograph. This is known as the "unitime exposure system." It can be attached to any lens that has an iris diaphragm. The readings on the lens scale are the regular "f" readings, only that the spaces between the regular "f" readings are split up in tenths so that it is possible to get the correct lens-openings whether the copy is reduced or enlarged. With this system, the exposure-time is always the same for any certain copy whether it is to be used for line, half-tone or color-separation negatives. Printed instructions give screen distances, light chart and exposure time. All three devices working in unison produce a great reduction in costs.

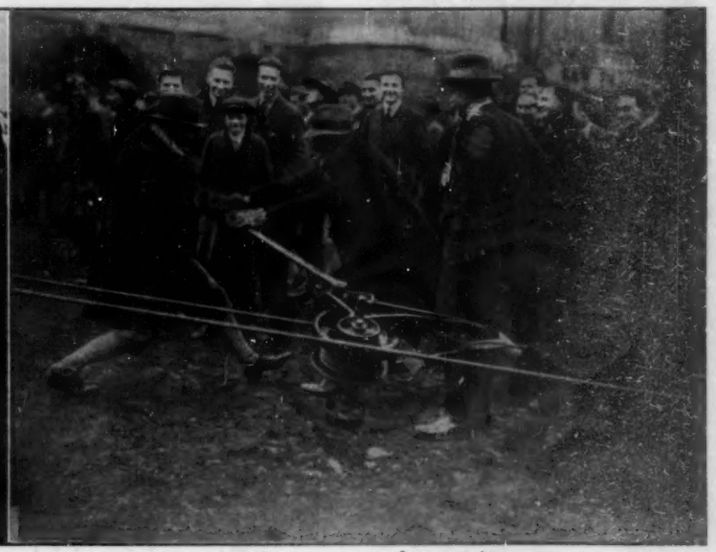
Antique Electric Lamps Recovered

THOMAS A. EDISON, in 1884, sent some of his first samples of electric lights to Leadville, Colorado. These same lights recently were salvaged from the ceiling of an old church there. Perhaps one reason they have lasted so long is because the church served a mining community and was used only once a year. A sample of the type of lamp just recovered is in the collection at the Smithsonian Institution, where it is carefully preserved. The four that were in the Colorado church burned at the annual services until an electrician set about to modernize the lighting system and salvaged the valuable electrical antiques.

Europe's First "Air Lorry"

EUROPE soon is to have its first "air lorry." Work has been started, in London, on a three-ton freight-carrying machine to cope with the increasing air-goods traffic between London and the Continent.

Stump uprooted by a "monkey winch"



Stump pulling appears to be a pastime

Rubber building blocks

Rubber Blocks for Children

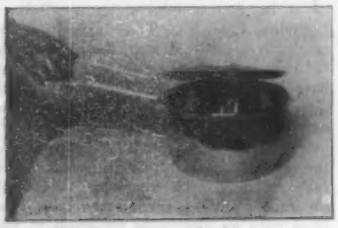
TOY blocks are now made of rubber as shown in our upper left-hand illustration. These blocks do away with the danger of accidents in case small children should throw them at each other. The toys come in various colors, and can be cleaned in warm soapsuds without injury.

Large Magnet Gathers Nails from Roadways

TO pick up nails and other stray pieces of metal from bridle paths and motor roads, the Bureau of Public Buildings and Grounds in Washington, D. C., has devised a cart carrying powerful magnets and shown at the top of the page. The magnets are energized by current from a storage battery.

A Gravel Drain Pipe

THE drain pipe shown in the upper right-hand illustration is made of small select gravel, to which is added a strong binder that makes for great strength as well as porosity. The pipe will stand 1,410 pounds pressure per lineal foot, and has a drainage capacity of ten times that of any other type. Water is absorbed throughout the entire surface of the pipe. The ends are concave and convex, making a close-fitting



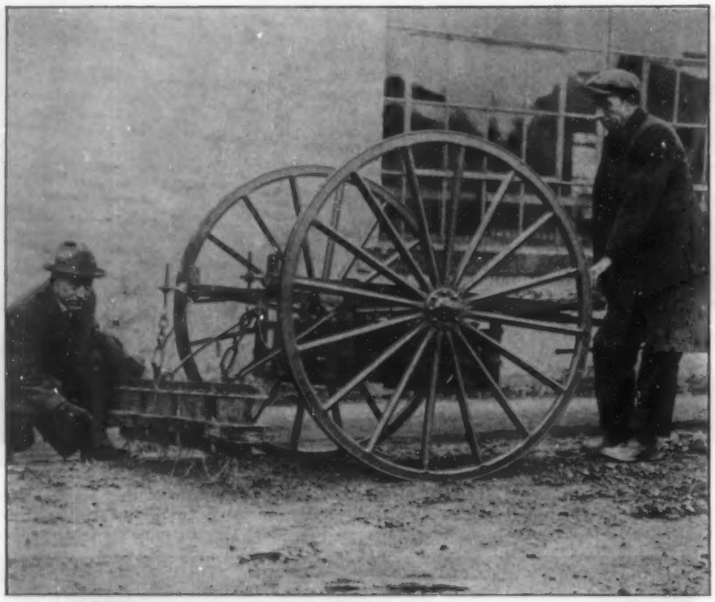
The lid stays with the pan

connection and thus permitting no foreign matter to collect inside the pipe to prevent the free drainage of water.

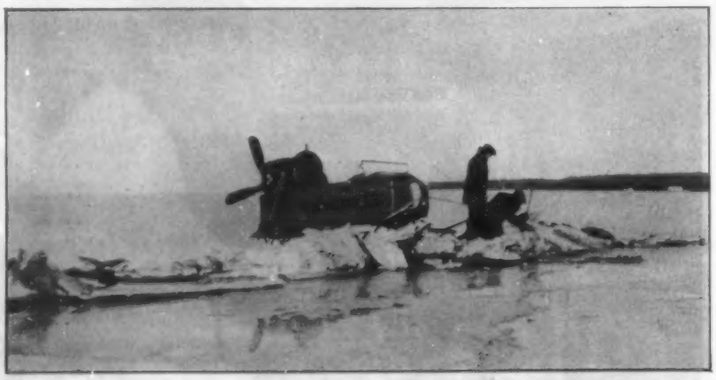
A Powerful Auto-sled

AN auto-sled or sleigh shown in two of our illustrations makes possible speedy communication between points separated by ice and snow that would be impassable for automobiles. This auto-sled is driven by an airplane propeller. It is said that it can attain a speed of more than 75 miles per hour. Between Mackinac Island and St. Ignace on the Michigan mainland, this sled,

A truck with great leverage



Cart for picking up nails and other articles from roadways. Some of the scraps that have been picked up may be seen clinging to the magnets



Auto-sled driven by an airplane propeller. This device is applicable to use on either snow or ice, the only changes being in the runners used

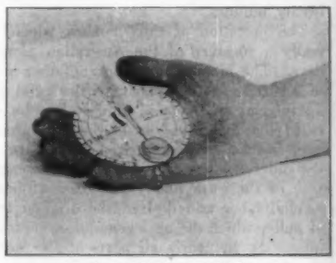
This auto-sled traveled six miles in seven minutes over clear ice

Porous drain pipe

under test, traveled six miles in seven minutes over a smooth, icy surface. The motor is of 110 horsepower. Tonneau, propellers, floor and seats are of the airplane type. The runners are of band-saw steel, wide for snow and narrow for ice. The sled is moved by the five and one-half foot hand-carved propeller placed on the rear, which is attached directly to the crankshaft of an automobile motor. The machine, which can carry several passengers, will run smoothly at a walking speed, yet picks up speed quickly. It can climb any hills that an automobile can travel. Driver and passengers are protected by a windshield. The material used in the body construction is very light.

Safety Cooking Pan

THE essential feature of this pan is that the cover is attached to the pan so that the operations of cooking are carried on efficiently. The cover allows stirring and yet a simple slip-pin permits the lid to be taken off for cleaning. After cooking, the food can be drained through holes in the lid.



A pocket sun-dial

Springless, Windless Watch

WE illustrate a springless, windless watch which will tell the approximate standard time in any locality, providing the sun is shining. The shadow cast will indicate the time, to which should be applied a correction figure. The device is, in reality, a small sun-dial.

New Truck Lightens Labor

WITH the truck shown at the right and left at the bottom of the page, one man can handle 500 pounds. The construction is clearly shown in the illustrations. The truck is very handy for getting in small corners.

Handling heavy barrels easily

The Scientific American Digest

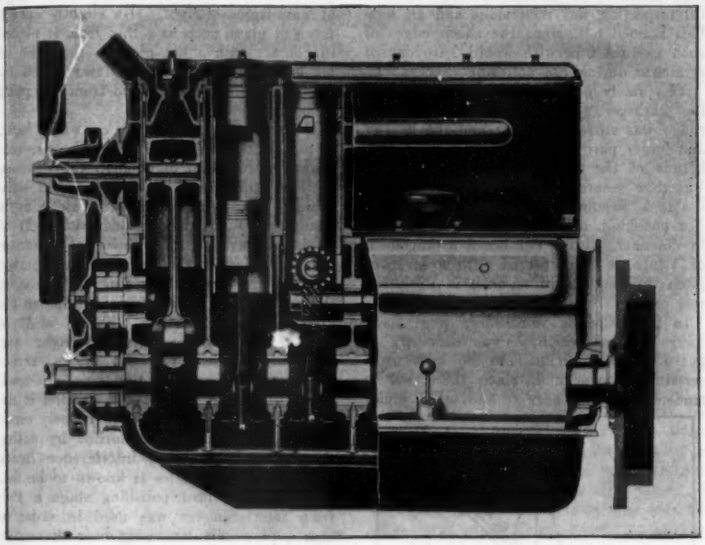
A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

A New Type Automobile Engine

AN announcement of great interest to the automobile world is that of the production of the Argyll engine which, as will be seen in our illustrations, has several unique features.

A single sleeve-valve, cylindrical in form, having a number of specially shaped ports at the top and a single universal driving-connection at the bottom, is actuated by a short shaft consisting of a disc with an eccentric pin on the end engaging a universal joint at the bottom of the sleeve. This disc is driven by means of skew gears from the valveshaft—the equivalent of the camshaft on a poppet-valve type engine—and is rotated by the valveshaft. The eccentric pins on the latter impart a combined vertical and horizontal travel to the sleeves as the universal joints allow the sleeves freedom to rotate partially on their axes. The resultant path of each sleeve is therefore elliptical. That is to say, if a pencil point could be passed through the cylinder wall and held against a sleeve, it would mark an ellipse. The cross shafts run at half engine-speed. The ports in the cylinders are therefore uncovered by corresponding ports in the sleeves only once in a complete revolution of the valveshaft, or two revolutions of the crankshaft.



A partial cross-section of the new single-sleeve-valve engine

All of the valve mechanism is enclosed and runs in oil, reducing the wear, although the sleeve is larger and heavier than the poppet valves which it replaces. Less power is absorbed in its operation than is required to lift poppet valves against the pressure of the exploded gases in the cylinder. The continuous oscillation of the sleeve in a closed path is a low speed, harmonious motion, and has the advantage of lessening frictional resistance, and consequently wear, through its perfect lubrication. Carbon does not accumulate as quickly as in the ordinary poppet-valve engine as it obviously will not collect on symmetrical polished combustion heads or on the large wearing-surfaces of the sleeve. The valve action, being positive at all speeds, permits very efficient high-speed operation, thus increasing the horsepower as well as mileage per gallon of gas.

It is also obvious that this design eliminates a number of parts, which in turn reduces the cost of production; while the quietness of operation and lack of vibration will be appreciated.

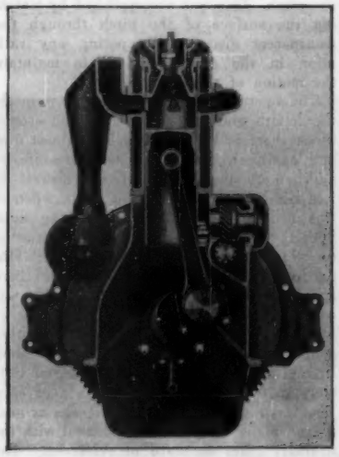
Two Scottish engineers, Burt and McCollum, were the inventors.

* * *

How High?

THE maximum height of the tall buildings which are being erected in New York City in these hectic days is increasing by leaps and bounds. Although that astonishing structure, the Woolworth Building, reaching 792 feet above the street, was built in the year before the War, it still retains its supremacy as the loftiest building in the world inhabited by man. The Eiffel Tower, 984 feet in extreme height, overtops, it is true, the Woolworth Building by nearly 200 feet; but the tower is not a building but an all-steel, framed observation tower, built by M. Eiffel for the Paris Exposition of 1880 and named after that distinguished engineer.

The era of the tower-like American office building was ushered in by the construction in 1907 of the Singer Building whose topmost point is 612 feet above the sidewalk. It was designed by one of our leading architects—Mr. Ernest Flagg. Then followed, in 1910, the Metropolitan Building, 700 feet in maximum height; only to yield the height record three years later to the Woolworth Building.



End-section of the new engine, showing valve-operating mechanism

The question not infrequently asked by the work-a-day citizen as he watches this modern attempt to pile Pelion on Ossa is "where is this sort of thing going to stop? Are there no limiting conditions which will prevent the extension of these steel and masonry wonders into the heavens?" The popular impression doubtless is that we must soon reach a limit at which the building must necessarily crumble under its own accumulated weight, or be blown down by the gales of the winter or the fierce, if briefer, tornados which hurl themselves at Manhattan Island in the shape of summer thunderstorms from New Jersey.

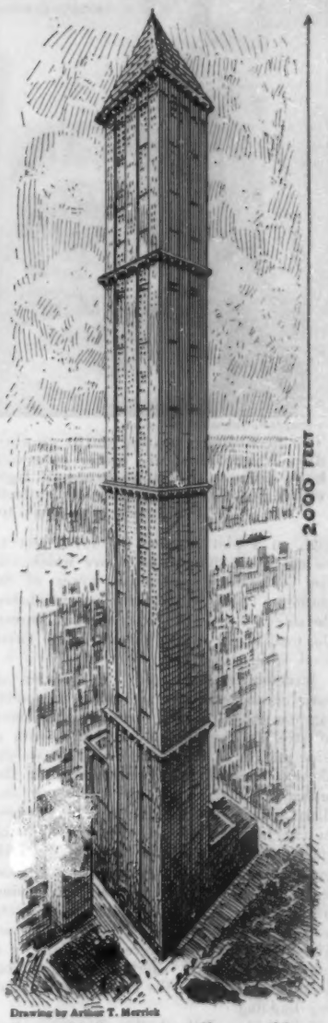
Now, as a matter of fact, the limit upon height comes neither from any inherent weakness of the building nor from the overturning or racking effects of the wind. Under existing conditions, the ultimate limit of height, so far as the strength and stability of the building is concerned, is determined by the Building Code of the City of New York, which says that the maximum pressure under the footings of the columns is not to exceed 15 tons per square foot on medium rock, or 35 tons per square foot on the best ledge rock of Manhattan Island.

With a view to ascertain to what height it would be possible to carry a building, we consulted Mr. O. F. Semsch, the engineer of the design, who kindly made the calculations upon which the theoretical tower building shown on this page was drawn. It was found that, subject to a limitation of 15 tons to the square foot, and on a plot 200 feet square, it would be possible to carry a building up to a height of 2,000 feet. Mr. Semsch designed the steelwork of the Singer Tower, and the weights and other calculations of this 2,000-foot, suppositional tower were worked out on the same general principles as were used in designing the steel work of that structure. Mr. Semsch found, after various trials, that a building 2,000 feet in height would be within the foundation limit of the Building Code.

Assuming a thickness of 12 inches for the walls, and that one-half of the wall surface would be required for windows, he determined that the total weight of the walls would be about 52,000 tons. Assuming the dead weight of the floors and the interior construction at 80 pounds per square foot of floor area, the weight of that part of the building would be about 213,500 tons. The "live" floor load to be transmitted to the foundations, according to the requirements of the Building Code, would be about 100,000 tons. Adding these items, we get a total of 365,500 tons, which, distributed over the entire area of 40,000 square feet available for footings, would give about nine tons of pressure per square foot. After allowing for the increase of pressure due to wind and for the weight of the footings themselves, the total figure would still be well within the limit for medium rock of 15 tons per square foot. This would mean that there would have to be one solid block of concrete covering the entire area of the rock.

The total wind load on one side of this building, when exposed to a heavy gale of wind would be 6,000 tons, and as the center of pressure would be 1,000 feet above the street level, the overturning moment of the wind would be about 6,000,000 foot-tons.

Now, the layman might well be excused for believing that a horizontal pressure of 6,000 tons applied 1,000 feet above its base must surely turn the building over; but the deadweight of the huge mass is so great, that it would require, as a matter of fact, seven times as much wind pressure before the building began to lift on its windward side and overturn; for, opposed to the overturning moment of 6,000,000 foot-tons, there would be a moment of stability, due to the weight, of over 36,000,000 foot-tons.

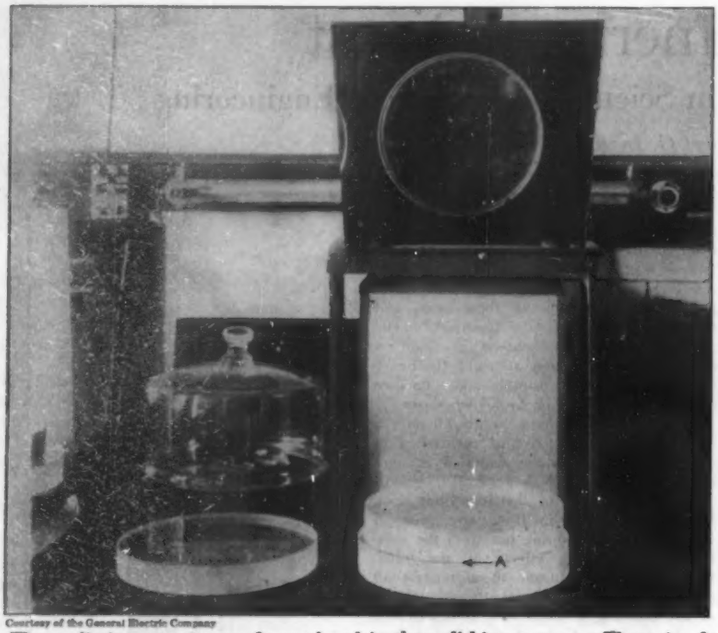


Drawing by Arthur T. Merrick

It would be structurally possible to erect a 2,000-foot building on medium quality Manhattan rock. Because of its enormous weight, it would have a wide margin of safety against overturning in a gale of wind. Economically, because of great space required for elevators, it would not be a paying proposition

It was the coming of the age of steel that made possible the lofty buildings of today. Before the era of steel, however, some astonishingly tall masonry buildings were erected. Thus, the Pharos lighthouse at the entrance to Alexandria, built by the Romans during their occupation of Egypt, was a massive all-masonry structure that was over 500 feet in height. Then, in medieval times the cathedral builders raised some wonderful towers and spires. The twin spires of Cologne Cathedral are 512 feet in height and the single spire of Ulm Cathedral is 525 feet in height. The loftiest masonry structure in the world is the Washington Monument with a total height of 555 feet.

Recently, there has been filed with the Building Department of this city by John A. Larkin and his brother the plans for an office tower building that will overtop by 224 feet the famous Eiffel Tower in Paris. This tower stands on a gigantic base 18 stories



Courtesy of the General Electric Company

The preliminary testing outfit employed in the polishing process. The pair of discs at the right are under observation while the ground-glass window at the back diffuses the monochromatic light. The interference fringes are observed either by direct vision or by reflection from the mirror above. The actual fringes are too weak to register in the photograph

high on a plot 250 feet by 197½ feet in its maximum dimensions, above which will rise a central seven-phase tower of 90 stories. There will be two stories below the sidewalk and 108 stories above the street, the total height of the building above street level being 1,208 feet.

Structurally considered, the question of carrying the enormous weight of the building was merely one of increasing the mass of steel in the columns to carry, with a wide margin of safety, the enormous weight above. These weights are known, and the matter of determining the necessary sectional area of the steel at any given height in the building is one of straightforward computation. As in the case of every tall building in this city, the stability moment is so much greater than the overturning wind moment, that the building is absolutely safe against any disaster due to this cause. The wind pressure, however, especially in a heavy gale of wind, exerts a strong lateral bending stress upon the steel framework of any building.

In the case of the Larkin Tower, a great deal of thought has been given to this matter, and a special design for the connections of the floor beams with the columns has been developed, which, in effect, constitutes at each floor, a series of massive and very strong knee-braces. These connections take care, not only of the bending stresses, but also of the severe torsional or twisting stresses to which a building of this character is subjected.

So far as the provision of elevator service and lighting are concerned, there will be 60 elevators arranged in ten banks, and the 4,500 windows, all outside, insure that every room will be fully lighted during the hours of daylight.

* * *

The Flattest Thing in the World

SURFACES so flat that any deviation from perfectness is too small for measurement have been produced by the United States Bureau of Standards, and henceforth will be the final word in deciding whether or not a surface really approaches flatness or straightness. The three discs, or optical flats, will not be used for direct comparisons but as master flats for checking the accuracy of the optical discs which are used in the work of the Bureau.

Measurements on the surfaces of these three discs, from 10 to 11 inches in diameter and one and one-half inches thick, fail to show any places where they are more than two ten-millionths of an inch from being absolutely flat. Such accuracy means that, magnified until the discs extended from Washington to Chicago, no point except along the margin would be out of absolute flatness by more than an inch.

These master optical-flats are made from clear, fused quartz, or silica glass, produced in the Thomson Research Laboratory of the General Electric Company at Lynn, Massachusetts. The product, commercially introduced two years and a half ago by the company, has many properties which make it superior to optical glass. It is much harder than glass and, upon being heated, it expands much less than does glass. The surface of glass, formerly used for optical flats, changes considerably in shape when touched by the hand, so sensitive is it to heat. Clear, fused quartz, which expands only one-fifteenth as much as does glass upon being heated, can be handled with much more impunity in this respect. The low coefficient of expansion of clear fused quartz also recommends its use for astronomical mirrors and for the manufacture of standards of length. Its resistance to change at great heat has led to its use in the manufacture of thermometers which can be used at far higher temperatures than can be approached with glass ones.

In addition to serving as a test for flatness of surfaces and straightness of edges, these standards are used in the production of standard angles and for calibrating or checking instruments that measure curvature.

Limitations as to material and workmanship previously rendered precision in testing flatness to better than one one-millionth of an inch impossible. By the use of silica glass the precision has been increased five times. Since a standard plane should not vary from flatness by more than a ten-millionth of an inch, even the temperature distortions of glass cause irregularities greater than the desired degree of precision will permit. In the case of a glass disc, the tested and testing surfaces must be left in contact for several hours before they have recovered from the surface warps caused by slight handling or by temperature changes. Clear, fused quartz, with its much lower coefficient of expansion, is affected by temperature changes to a much less degree.

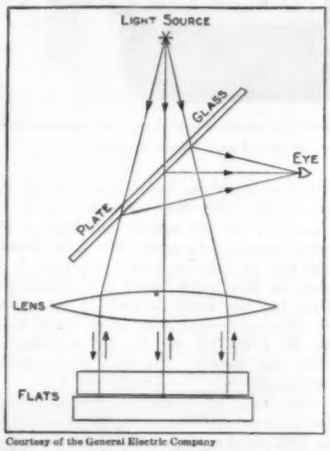
C. A. Skinner, chief of the optics division of the United States Bureau of Standards, in speaking of the production of the quartz optical flats, says, "It is one of these rare accomplishments in which the craftsman has worked with a degree of precision equal to that with which the laboratorian can measure." The polishing of the discs was done by John Clacey and the testing by C. G. Peters, both of the optics division.

The slabs of clear, fused quartz, as received from the General Electric laboratory, were first rough-ground in the optical shop of the Bureau of Standards at Washington. After the rough grinding, all of the work was done by hand on a circular pedestal by swinging the 13-pound discs in ever changing loops and turns over a grinding or polishing table.

With three sizes of carborundum powder as an abrasive—coarse at first and finer for the later stages—the three discs were ground against each other until a straightedge failed to reveal inaccuracies. A careful inspection was then made and all bubbles reamed out, since the sharp edges of such cavities otherwise would have caused scratches during the polishing process.

Very finely powdered rouge was used as the abrasive during the polishing. The rouge was stirred in water and the heavier and larger particles allowed to settle to the bottom of the tank. Uniformly fine rouge was then secured by dipping a brush into the tank, keeping it well above the bottom. For polishing, a cast-iron plate nine inches in diameter, with a checkered arrangement of V-furrows and covered with a layer of pitch three-eighths of an inch in thickness, was used.

In the polishing work there were many things against which it was necessary to guard. The pitch had to be kept at a certain hardness and, since there was a tendency for it to heat up and soften under friction, the operator had to be alert for any sign of local or general softening of the pitch. This was accomplished by watching the surface of the pitch through the transparent disc and by noting any variation in the effort required to maintain the motion of the disc.



Courtesy of the General Electric Company

Diagram of the optical arrangement which permits the eye to be focused on the flats through a lens, in order to view simultaneously all parts of them with perpendicular vision

The operator also had to judge properly the length and type of stroke used—sometimes short and again long, sometimes oval and again circular. At times, pressure in addition to the weight of the disc itself was needed, and there were times when it was necessary to stop the polishing until both the quartz and the pitch had returned to normal temperature. The pitch also needed to be reformed at times, and here again the expertness of the operator was called upon.

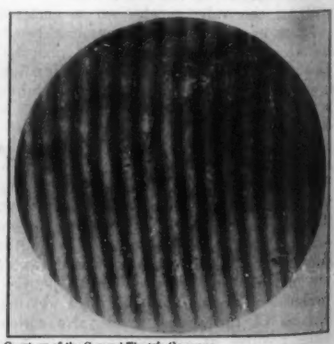
There were three steps in the polishing process. Both sides of the three discs were first given a high-grade polish, but no tests were made for flatness. One face of each disc was then polished so that it was as near a true plane as could be indicated with the ordinary glass standard of reference. The test for flatness was made by bringing the two surfaces together and observing the interference bands formed by monochromatic light, or light of a single wavelength. When viewed perpendicularly, these interference bands are straight lines if the surfaces fit, whether plane or curved. If three surfaces brought together in pairs fit, they are plane; this is why the three surfaces are necessary. If viewed at an angle, rather than perpendicularly, the lines are curved and, since the line of vision is perpendicular at only one point at a time, a special device is needed in observing the lines.

The explanation of the interference bands is that two trains of light waves from slightly separated images of the same light source neutralize each other at certain points, thereby causing alternate light and dark bands. This is because the separated images give two entirely similar and synchronous series of wave-trains of light. If a slightly curved piece of glass, such as a thin lens, is placed in contact with a flat glass, a thin film of air is enclosed between the two which increases in thickness outward from the point of contact.

If examined in sunlight, or white light, a number of colored rings are seen surrounding the point of contact, the distance between the rings depending upon how rapidly the thickness of the air film is changing. But if illuminated with light of a single wavelength, a series of alternate light and dark rings are seen, the distance between the rings depending not only on the thickness of the air film but also on the kind of light. Similarly, light of a single wavelength produces alternate light and dark bands when two flat pieces, rather than a flat piece and a thin lens, are used. These bands are straight and parallel if the glass plates are flat, and an extremely sensitive test for flatness is afforded by noting the straightness of the interference bands when one of the plates is known to be flat.

During the third polishing stage a Pulfrich interferometer was used in order to obtain perpendicular vision over the entire surface. The first comparison of the surfaces with this instrument showed that the surfaces were within 0.6 wavelength or twelve one-millionths of an inch of being perfectly flat. One was slightly hollow or concave, another was slightly humped or convex, and the third had a slight elevation between the center and the edge. A single polishing operation reduced each of these irregularities by half, and a second one completed the work.

With the standards at hand it was not possible to test further the new optical flats, so that from there on, it was necessary to test by comparing one with another. The polishing and measurements were continued until it was determined that each varied by less than one one-hundredth of a wavelength or two ten-millionths of an inch from being a truly flat plane at all points. There was no method for testing the surfaces beyond this point for, so far as could be determined, the interference lines were



Courtesy of the General Electric Company

Interference fringes as seen by light reflected from the two contact faces at *A* in the upper illustration. Viewed perpendicularly—a result made possible by the apparatus shown diagrammatically in the center drawing on this page—they would appear perfectly straight

straight at all times, no matter how the surfaces of the three clear, fused quartz discs were placed one on another.

* * *

A Correction

IN the issue of February, page 125, under the caption, "Good News for the Lover of Science," we stated that the price of the Eighteenth Annual Report of the Smithsonian Institution was $1.50. We have been informed by the Smithsonian Institution that this is the price quoted by the Superintendent of Documents, Government Printing Office, who holds all public documents for sale, but that the report may be obtained free of charge, directly from the Smithsonian Institution, located at Washington, D. C.

* * *

Further Enforcement of Tennessee Law Unlikely

VIOLATION of Tennessee's anti-evolution statute is now virtually impossible, under the interpretation placed upon the much-discussed law by the state supreme court, according to Henry E. Colton, counsel for the Tennessee Academy of Science in the appeal from the decision of the lower court after the Dayton trial. The only way in which a Tennessee teacher could now force himself into the law's clutches would be by directly inculcating doctrines of materialism or atheism in connection with evolution. He can teach pure and simple evolution as much as he pleases, so long as he leaves religious denial out of the discussion. "The supreme court has rather clearly indicated that it wishes to get rid of this case, and the attorney general is apparently likewise of the opinion that it is to the best interest of Tennessee not to prosecute this case further," Mr. Colton says. "In fact, under three opinions rendered in the case by the four judges now living, it would seem probable that the state could not obtain a conviction in this case unless upon retrial and reappeal to the Tennessee supreme court it should win over the fifth judge, Swiggart, who did not participate in the case.

"An examination of the record indicates that John Thomas Scopes taught the generally accepted scientific theory as to the evolution of man without in any way denying the divine origin of man. Under liberal interpretation of the Biblical stories, there is no conflict between the scientific theory of the evolution of man and the Biblical stories which teach the divine origin of man but do not specify the gradual process by and through which he was created.

"Two of the judges, Chambliss and McKinney, have held in substance that the mere teaching of the scientific evolution theory as to the origin of man does not constitute a crime under Tennessee law. Judge McKinney so holds because in his opinion the Anti-Evolution Act is unconstitutional for uncertainty. Judge Chambliss so holds because in his opinion the contention of the defense is correct that the teaching of the generally accepted scientific evolutionary theory as to the origin of man is not made an offense under the Anti-Evolution Act unless the teacher goes further and denies the divine origin of man. In other words, Judge Chambliss construes the statute as condemning the teaching of materialism or atheism, but not as condemning the mere teaching of the scientific theory of evolution of man as generally taught.

"If the state does not have sufficient confidence in the act to proceed against Scopes under the foregoing circumstances it seems questionable whether it will ever undertake to enforce the act unless a teacher should not only teach the scientific theory as to the evolution of man but go further and undertake to teach materialism and deny the divine origin of man."—*Science Service.*

* * *

The New Physics

AT last a textbook of physics has been published, in which modern subjects such as the physics of the atom, the electron, radioactivity, the quantum theory and all those parts of physics which have developed during the present century, are embodied in the text and are intimately woven in with it, instead of being segregated in a sort of "doubtful" compartment in the back of the book. In Sheldon, Kent, Miller and Paton's "Physics for Colleges" (Van Nostrand, New York) there is no suggestion of the conservatism which evidently regards these newer things as different in some inherent manner from the rest.

To illustrate: most textbooks treat electricity and magnetism first, the electron is reserved for the "modern" annex in the back. But the new book recognizes that a consideration of the electron should and does logically underlie the treatment of electricity and magnetism; therefore the discussion of electricity and magnetism begins with that of the electron. Again, in one section, sound and electricity are considered together. This is rather unconventional, yet it is logical, for are they not both wave motions? The newer physics and the older physics are of a piece. To separate them tends to foster the idea that they are not. Here, however, they are merged together.

The new book is relatively non-mathematical; the reviewer sees in it nothing "worse" than algebra, a point which, it is no secret, will be appreciated by a great many of us whose higher mathematics are just a trifle rusty. The language is rather informal, often almost chatty. For these reasons we recommend this book to those of our readers who wish to review their physics at home, as well as to those who wish to gain the fresh point of view to be had by passing in review the newer knowledge in the ranks with the old.

* * *

The Groundhog Is a Poor Prophet

DID the groundhog see his shadow last February 2?

Whatever may be the opinion of the rest of us regarding this much-disputed beast's reliability as a weather prophet, there are two individuals who preserve a disdainful silence; and they are the very ones who know most about the matter. They are the groundhog, who obviously knows more about groundhogs than any mere human can know, and the weather man, who checks up on past weather to see how prophecies pan out, an interesting and informative proceedure which few of the rest of us take the trouble to follow out.

Last year February 2 was clear in the east and cloudy in the west. Therefore the east should have had six weeks more of winter, whereas spring should have broken early over the west. As a matter of cold fact, winter lasted more than six weeks longer in both sections, so that the groundhog was right in one place and wrong in the other. And being right only 50 percent of the time is not good prophesying; mere guessing, or the flip of a coin, can hit it as well as that.

Moreover, the unreliability of the groundhog holds for a period of years as well as for a spread on the map. F. W. Saward, a meteorological scientist, has made a statistical study of the weather for six weeks following February 2, covering a period of 15 years. According to the proverb, nine of them should have been cold, but only four of them were. Of the six that were to have been warm, only two were correctly indicated. So again the groundhog was shown to be not only a poor prophet but not even a good guesser.

However, the groundhog is not at all concerned about the impugning of his reputation as a weather prophet. He never asked for the job. It was wished on him by the early settlers, who had a similar superstition about the European hedgehog. Not finding hedgehogs in this country, they chose the groundhog to bear the burden of their own sometimes-right, sometimes-wrong weather wisdom. And so for one day each year the groundhog is the most-discussed animal in fur.

It is highly unlikely that whether the sky be bright or cloudy on Candlemas day the groundhog bothers to come up at all to look for his highly important shadow, at least north of the Mason-Dixon line.—*Science Service.*

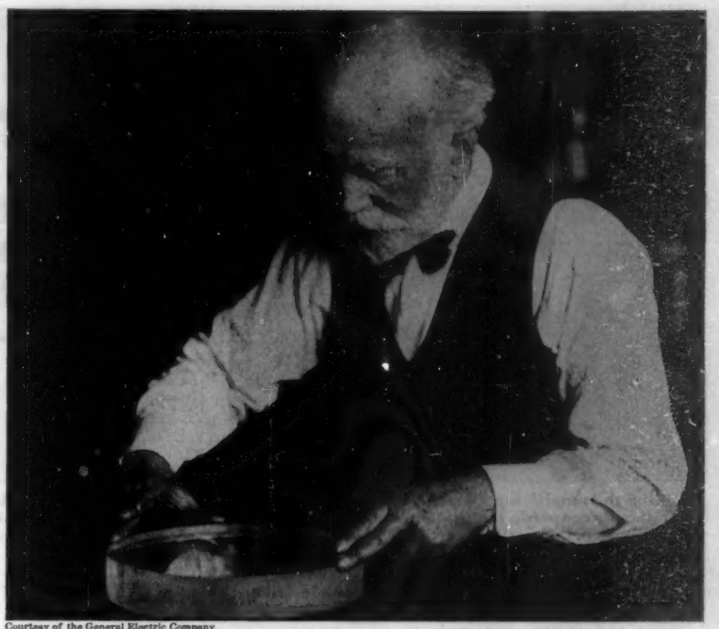
* * *

Making and Unmaking Matter

THE greatest scientific achievement of the nineteenth century, in the opinion of those who lived in that century, was the formulation of two fundamental physical laws of the universe, the conservation of mass and the conservation of energy. According to these, says Edwin E. Slosson of *Science Service*, matter and energy were immutable in amount and neither could ever be created or destroyed in the minutest measure.

But the twentieth is an unsettling century. Such mental revolutionists as Einstein, Planck and Bohr have opened our eyes and widened our outlook. We cannot be so sure about many ideas as were the simple-minded scientists of the former century. Some of the generalizations which seemed to them absolute and universal principles of nature appear to the more critical eyesight of the present generation to be disguised definitions; similar, as Eddington puts it, to the Great Law to which there is no exception, that there are three feet in every yard.

For instance, the law of the conservation of energy. We see a lump of burning coal giving off energy at a great rate as radiant heat and light. Where did that energy come from? Where was it when the lump was cold, if no energy can be created in the course of combustion? The reply of the nineteenth century chemist was clear and decided. The energy was there all the time in exactly the same amount, although its presence could not be demonstrated because it was in the form of "potential energy." Obviously this was unanswerable as an argument, although not very enlightening as an explanation. We are nowadays disposed to suspect that this "potential energy" was put into the coal by logic rather than by geology, and that if it exists in nature at all it is in the nature of the human mind. The twin laws of conservation of matter and energy are as useful as ever, for they still serve to clarify our conceptions and to guide our experimentations. No experiment has ever been able to detect the slightest flaw in them, and it may never be possible to devise tests so delicate as to disclose any discrepancy. Yet neither law is now regarded as absolute in itself and it seems that we shall have to substitute a general law which will include the two and allow for the transformation of matter into energy and vice versa. Einstein has worked out the formula for the equivalence of matter and energy, so we can now calculate how much heat will be produced if a certain mass of matter is annihilated. This idea has been welcomed by the astronomers who have long been hard put to it to devise means of keeping up the furnace fires of the sun as long as mankind would like to live. They have now figured out by Einstein's formula that the sun is losing weight through the destruction of its material and the emission of immaterial energy at the rate of four million tons a second. But even though wasting away at this appalling rate, the sun can hold out for ten million million years. This gives a welcome extension of time for the life of our world and permits us to hope that we

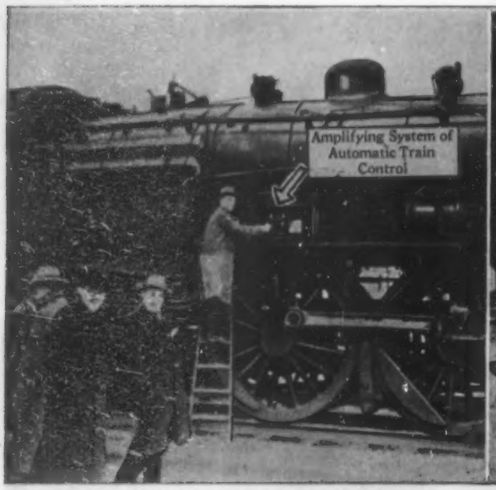


Courtesy of the General Electric Company

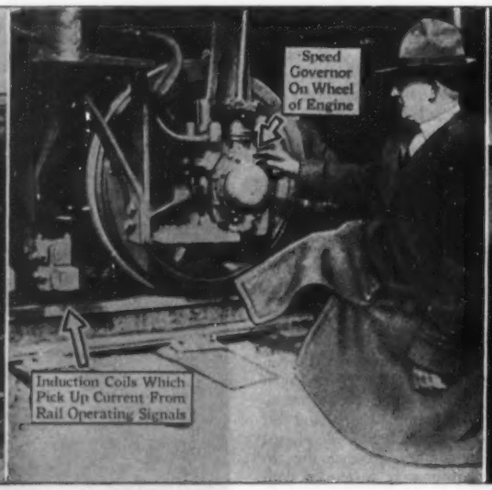
How the quartz flat is polished. It is swept over the special polishing surface in ever-changing loops and turns. The picture shows Mr. John Clacey, the expert

Courtesy of the General Electric Company

Three finished discs of clear fused quartz, about ten inches in diameter and one and one-half inches thick. Their surfaces depart only one 5,000,000th of an inch from absolutely true planes. This is probably the most accurate work that man has ever performed in any material



Showing the amplifying elements on an engine fitted with the three-speed, induction train-control system which is described in the text below



Left: the induction coils on the engine. *Center:* Centrifugal governor which set brakes when a speed of 85 miles an hour is attained

The letters H, M and L indicate to the engineer the speed at which he may run in the block occupied by the train he is operating

may get our social system perfected before we all become Eskimos.

This principle of the interchangeability of matter and energy must apply to all chemical reactions where heat is produced or absorbed. Wherever coal burns, there matter is being converted into radiant energy. Wherever a green leaf grows there matter is being manufactured out of solar energy. In such cases, of course, the quantity of matter or energy transmuted is too small to be demonstrated. In the burning of coal the heat evolved means a loss of about one part in ten billion of the joint mass of the carbon and oxygen combined. But this loss of matter becomes appreciable when we consider the world-wide consumption of coal. If we assume that all coal is pure carbon and that the combustion is always complete, the carbon dioxide produced by all the coal that is burned in a year throughout the world would weight about five billion tons. This would involve a disappearance of matter amounting to half a ton. The substance of the world is therefore being slowly consumed by the combustion of coal.

* * *

The Heath Hen's Last Stand

On the island of Martha's Vineyard are the only heath hens in the world, according to *American Forests*. There are, so far as anyone can tell, about thirty-five of them and whether or not they are soon to become an extinct species is a perplexing problem among those interested in this unique bird.

"The hunter is only partly to blame for the extinction of the heath hen on the mainland," says Pendleton Dudley, the author. "It is true that the bird was hunted without mercy, but even without the dog and gun, it could not have stood the encroachments of civilization, for this game bird thrives only in a particular sort of cover. It does not take to the deep woods, but chooses instead regions covered with small trees and thickets, building its nest and rearing its young close to the ground. As the country became settled, regions of this sort usually disappeared first, and those which were left were so mercilessly exposed that they no longer proved a paradise for wild life.

"The state of Massachusetts," he continues, "set aside a reservation in the heart of the island plain, and for some years has spent large sums of money to protect the surviving heath hens. In the early spring of 1916, the superintendent of the reservation estimated that there were two thousand birds on the island; but in May a large and disastrous fire swept the thickets and destroyed most of this large heath-hen population. The birds which were on their nests burned to death without even trying to escape. Following the fire, and after diligent search, only one hundred and fifty survivors could be counted.

"The island's pride in the unusual bird is much in its favor. A few years ago a resident of West Tisbury, the town closest to the breeding places of the heath hen, looked out of his window in the early morning and saw a heath hen walking up and down between the rows of his potatoes and picking off potato bugs. This early morning activity, which had apparently been going on for some time, accounted for a most unusual phenomenon which the West Tisbury man had not previously understood —the unprecedented absence of potato bugs that year.

"In the times when there were about two thousand birds," concludes Mr. Dudley, "attempts were made to transfer some of them to other localities, but the experiments always failed. In recent times, heath hens have not bred except on Martha's Vineyard. It is to the plains of this island, therefore, with their thickets of scrub oak that the future must look if it is to know one of the most remarkable as well as one of the most truly American game birds."

Reproduced from *American Forests*

Is this bird slated for extinction? It is one of the last 35 heath hens left in the world

* * *

Automatic Train-control

The Reading Railroad has recently installed on its Atlantic City division a three-speed, continuous, induction train-control system, which is operating with great success.

The term "three-speed" indicates that the trains are controlled through three predetermined speeds: high, medium and low. These speeds have been set at 25, 40 and 85 miles per hour. The system imposes the speeds on a train in accordance with track conditions as indicated by three signal indications; clear, caution and stop. High, or predetermined maximum speed, is imposed in clear blocks; medium speed between caution signal and the braking point of a stop signal; and low, or predetermined minimum speed, between this braking point and the stop signal and, also, in occupied blocks.

The term "continuous" means that the train is under control of this system at every instant from the time it leaves its initial terminal until arrival at destination. In other words, if a train should pass a "distant" or "home" signal at clear and the track conditions ahead should change or the block become occupied, this change of conditions would be immediately communicated to the cab signals and a brake application would be made by the control device.

On the other hand, if a train should pass a "distant" or "home" signal in the danger position and the track conditions should change so as to remove the factor which had held these signals at danger, this would be immediately communicated to the cab signals and the control released so that the train could proceed at the maximum speed.

This system differs from the intermittent type of train control, where the control is effective only at certain points along the line, such as where wayside ramps are placed. The advantages of the continuous type are apparent so far as safety is concerned. It also increases very materially the capacity of the main tracks, permitting a larger number of trains to be operated, and these closer together.

The term "induction" means that the source of control is affected by electrical induction. Coils on the front of the engine pick up the signal current from the rails by the old familiar principle of induction.

The continuous automatic train control serves as a connecting link between automatic block-signaling and the automatic air-brakes on the engine and cars. It is an interpretation of track conditions in terms of train speed. It enforces the operation of trains in accordance with signal indications and track conditions, without relieving the engineman of any of his responsibilities. So long as he complies with signal indications ahead, the control and operation of the train is left entirely in his hands, and so long as he complies with signal indications and speed restrictions there is no indication that the train is even equipped with train control; *but should he fail to comply with them, the system takes control and either stops the train or reduces its speed.* In such cases, it applies the brakes; but it never releases them.

Brake applications are made automatically but the release of such applications must always be made by the engineman himself. If for any cause, he cannot release the brakes, his train is brought to a stop.

The train control system provides the engineman with a continuous, visible indicator in the cab of the locomotive from which he can at all times determine at what speed it is permissible for him to run. Any changes in conditions immediately ahead of him, are instantly registered on his cab indicator in sufficient time to enable him to increase or decrease his speed, as the case may be. In other words, whenever the cab indicator shows an "H," it means that he can run at 85 miles per hour; when cab indicator shows "M," he may run at 40 miles, and when "L" is shown, he must keep his speed within 25 miles per hour. If an unforeseen occurrence should happen, such as a switch being opened or a rail breaking immediately ahead of train, his indicator gives him instant warning and the brakes are automatically applied.

The train control also requires the engineman to take some definite action at certain points to prove that he is alert and at his failure to do so, his train will be stopped. This definite action is known as "acknowledging." In other words, when the cab indicator goes from "M" to "L," which is the case when approaching a danger signal, the engineer must operate a valve known as the acknowledging valve. If he does this, he may then proceed at 25 miles per hour; but failing, the train will be brought to an absolute stop. This is always a check, when approaching a danger signal, that the engineer is alive and in full possession of his faculties and operating his train in accordance with the signal indications. If he is not, the train will be stopped.

International Newsreel

The speed-control device and the induction coils of the control system

Under proper restrictions, this train control permits one train to follow another into an occupied block; but it will always hold the following train to 25 miles per hour. Should the first train clear the block by accelerating or taking a siding, the fact is instantly recorded by the indicator of the second train, which can then, in turn, accelerate.

All the mechanisms of the train control, wayside equipment and engine equipment operate on the closed circuit principle, which requires the apparatus to be energized due to the presence of current in order to permit the engineman to run above the low speed limit. The failure of that current flow will stop the train or bring its speed below the minimum permitted.

This system requires no trackway elements other than the running rails themselves and does away with all devices such as ramps or trips, which must be placed at close clearance to the tracks. The wayside apparatus for this system consists of relays, transformers, wire connections, et cetera, as ordinarily used with automatic signals and they are located well outside of the clearance limits.

* * *

Auto "Shimmy" Blamed Largely on Tires

WHY does an automobile "shimmy?" This is the question that was seriously discussed by Karl L. Hermann of the Studebaker Corporation of America speaking before the Society of Automotive Engineers at its recent Detroit meeting.

As drivers often discover, a motor car under certain conditions shakes and dances, the action being confined mostly to its front end. Mr. Hermann classified the auto antics as: Kick-back or wheel-fight, that begins at about 25 miles an hour and makes the steering wheel hard to hold: Tramp and gallop that begins at about 45 miles an hour and is a slow vertical or swinging movement: Incipient shimmy that begins at about 45 miles an hour and appears as a side movement of the radiator cap combined with wheel-fight and violent shimmy that comes at 60 miles an hour, causes doors to shake open, and can not be driven through. In violent shimmy, Mr. Hermann explained, "three radiator caps seem to exist where only one should be."

Tires are most to blame for automobile shimmy. While improper alignment and balance of wheels, springs, lubrication, and wavy roads all have some influence on shimmy, the fundamental causes are in the tires. Tires are not often well balanced due to the valve and the overlaps of layers inside the casing. Morever, use of balloon tires has caused inflation pressures to become as important today as the motor itself, yet causes, such as temperature, leakage, et cetera, over which the driver has little control can vary the pressure as much as 10 pounds. And low or uneven tire inflation will often cause shimmy.

When various forces so combine with recurring regularity as to tend to lift the car from the road, some sort of shimmy will occur, Mr. Hermann explained. Since complex factors unite to cause shimmy, a cure in one case will not always be effective in another. But Mr. Hermann declared that the problem could be solved by tire and wheel manufacturers experimenting and producing more uniform and better products. —*Science Service.*

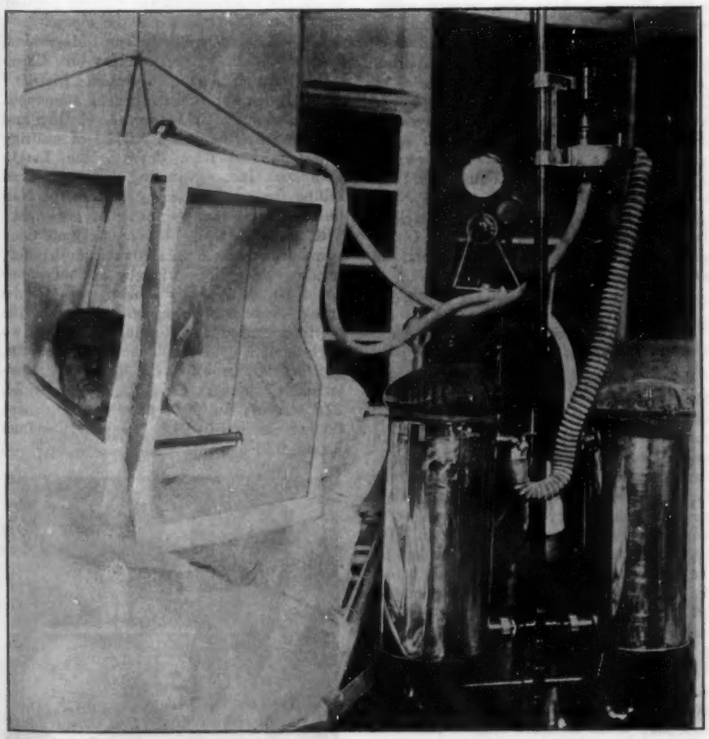
* * *

Oxygen Plays the Role of Nurse

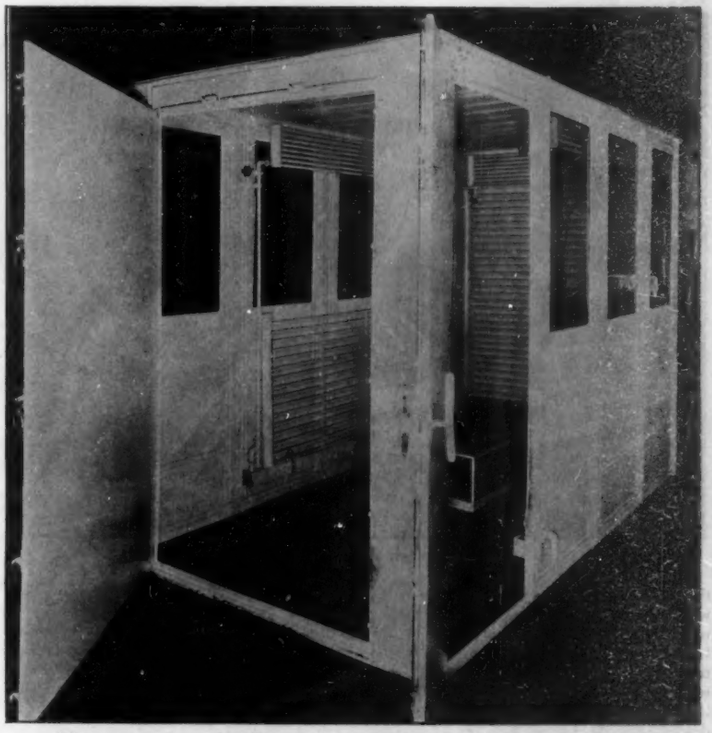
ONE of the most recent developments in medical science and one of the easiest technical advancements for the layman to understand is the oxygen chamber, used to save critical pneumonia cases. It was designed by Dr. Alvan L. Barach of the Presbyterian Hospital, New York City. That hospital is cooperating with Columbia University to form one of the largest medical centers in the world.

The use of oxygen as a restorer is nothing new. As long as 200 years ago it was advocated by chemists and doctors. But, as applied then, it was not found very serviceable. Little was known of the amount that should be given a patient under definite circumstances, and so unsuccessful was the work done with oxygen that doctors came to look askance upon its use.

During the last few years, however, intelligent experiments and cautious usage have tended to give to science a more definite idea of just what oxygen means as a therapeutic agent. Clinical cases which have come under the observation of the men who are developing the medical use of oxygen in a broad way illustrate the fact that it may prevent death in many pneumonia cases.



The Barach oxygen tent within which a patient is breathing air abnormally rich in oxygen. The apparatus is described in the text



The new oxygen chamber used in treating critical pneumonia cases

The oxygen tent was one of the first satisfactory appliances used in administering the element to patients. Others, such as the mask, caused some discomfort. An illustration in these columns shows how the tent operates. It uses oxygen with little waste, because the fabric is relatively tight and the enriched air within is constantly recirculated. The large cylinder at the rear is the supply of oxygen at high pressure, which is fed slowly into the tent. The regulator at the top of the cylinder fixes the amount of pressure, and the gauge indicates the flow of oxygen in liters per minute. The cylinder at the right of the movable apparatus contains ice which cools the oxygen, so that the temperature in the tent may be comfortable for the patient. In the other cylinder at the left is soda-lime, which absorbs the carbon dioxide from the air.

Thus the oxygen passes over the ice and into the tent. Thence the air passes out, through the soda-lime tank, over the ice and back into the tent. The apparatus seen between these two tanks is for testing the percentage of oxygen in the tent. This tent can be in operation in 15 minutes.

The new oxygen chamber seen in another illustration, operates on a different principle. Its main advantage over the tent is that it provides greater comfort for the patient. This chamber is constructed of aluminum and made so as to be airtight. From its first form it has been improved constantly until it stands as pictured here. Only five such rooms exist, two in England (one of which is at the Guy Hospital), one at the Mayo Hospital in Rochester, Minnesota, one at the Rockefeller Hospital and this one at the Presbyterian Hospital, New York City. Despite its completeness, it can be constructed for as little as 2,500 dollars. This chamber is different from others in that it does without motors and fans for its ventilation.

"The inside of the chamber is lined in certain places by aluminum pipe which contains circulating cold water," Dr. Barach says in describing it. "The water enters the pipe at one side of the chamber and leaves at the other. The exit water returns to the drain. A large soda-lime container is placed under the bed. No other apparatus is required.

"The air in contact with the cold aluminum pipe is chilled, the moisture is condensed on the surface of the pipes and the cool, dry air passes to the floor of the chamber where the carbon dioxide is removed by contact with the soda-lime. The air is warmed by the heat of the patient's body and passes to the roof with additional moisture and carbon dioxide. It is then chilled again and the process is repeated. By the use of these convection currents there is obtained an adequate removal of carbon dioxide, moisture and heat."

It has been found through clinical experiments that between 40 and 60 percent of oxygen is the right amount for a patient. This rich mixture acts well as a therapeutic agent, but it is believed that in most cases an increase of the percentage of oxygen in the air beyond 60 percent will not act favorably.

Because doctors have been inclined to look upon the use of this type of therapeutic agent with little confidence, by reason of the fact that the procedure is new and needs further trial, the tent and the chamber have not been used to any great extent except as a last resort when every alternative had been employed in an attempt to save a patient's life. Nevertheless, of ten test cases treated at the Presbyterian Hospital in the oxygen tent, seven recovered, while of six critical cases treated in the portable chamber, four recovered. All but one of the patients treated in the tent were gravely ill. These invalids were subject to the treatment for from two to seven days.

The first question which is naturally asked is: why not put the patients in the chamber or tent before their condition becomes critical? As confidence in the value of applying oxygen artificially in one of these two ways increases, it is believed that this means will be used more and more. Whether it will serve in other than pneumonia cases is still a matter for conjecture.

That oxygen actually *cures* patients is felt to be quite unlikely, but the opinion of scientists is tending more and more to hold that it fulfills its purpose by prolonging life until a patient has passed the crisis and is able to accomplish a natural recovery. In other words, the use of oxygen in this fashion is believed to be supportive and not curative.

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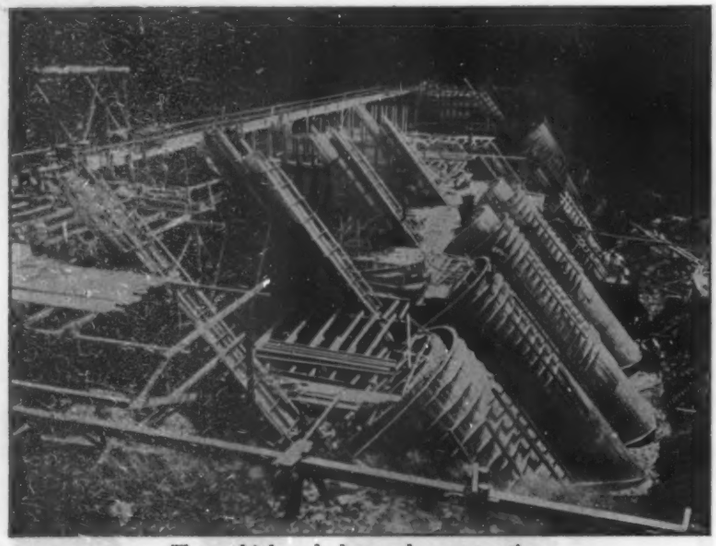
The Multiple-Arch Dam

LESS than a generation ago, masonry dams built for the storage of large bodies of water depended upon their mass or weight to resist



The multiple-arch dam under construction

the enormous pressure of the impounded water. The tendency of such a dam to be pushed bodily forward was resisted by the friction between the base of the dam and the rock on which it was founded. The tendency of the water pressure to overturn the dam, causing it to rotate about its downstream edge or toe, was met by making the dam extremely heavy—so heavy and so broad of base that the resultant of the horizontal load due to the water pressure and the vertical load due to gravity would strike the ground well inside of the toe of the dam.

A gravity dam has always seemed to the writer to be a very extravagant method of solving the problem, particularly when the dam was built of stone with the blocks laid in cement. The job was tedious and very costly, and even when built in concrete, as in later years, the gravity dam contained an extravagant amount of material. It has always seemed to us that since the masonry arch had proved to be a reliable form of construction to resist vertical loads, it should also prove satisfactory for carrying the horizontal water-loads that bear upon the upstream face of the customary gravity dam. Down through the years, we have waited expectantly for the day when engineers would apply to dam construction the well-tested principles of the masonry arch bearing against masonry abutments.

It is now nearly a generation ago that the first vertical-arch masonry dam was built across a narrow canyon in the Pacific Coast country. It contained only a fraction of the material which would have been necessary if the dam had been built on the gravity principle. That slender wall-arch from side to side of the canyon has stood successfully since its construction.

The next step was to apply the principle to dams which were so long as to render it impossible to build them in one single arch. In such cases the plan was adopted of spanning the opening with a series of arches carried upon a series of parallel piers or buttresses, whose up-and-down-stream dimensions and whose transverse thickness was varied to meet the stresses encountered.

To date, several notable dams of this type have been constructed and are giving good service. The arched upstream face of the dam is rather steeply inclined and the downstream edge of the piers is also inclined at an angle suitable to the loads and other conditions. It does not take an engineer to understand that there is an enormous economy of material in a dam of this character as compared with the solid gravity dam. One look at the accompanying picture suffices to make this clear.

Our illustration shows a dam of the above type during the course of its erection by Bykerhoff and Wilmernn at Voehrenbach in the Black Forest, Germany. The material of construction is reinforced concrete. There are thirteen parallel abutments supporting 14 arches. The arches were cast in place between inner and outer forms—the steel reinforcement being placed between the forms before the concrete was poured. The thickness, both of the piers or abutments, and of the arches, increases from the top of the dam downwards, in proportion to the increase of loads due to the pressure of the water and of the weight of the dam itself. At the top, the arches have a thickness of 32 inches, which increases to 48 inches at the foundations. The amount of material is only about one-quarter that which would have been required in a gravity dam and the time of erection has been cut in half.

* * *

Trout Census Taken by Fisheries Expert

ARDENT anglers have often conjectured as to the number of trout a stream of given size will support and fish-culturists have wished to know how many fish they can safely "plant" per mile of stream. Little information was available as it is not a simple matter to make such an enumeration.

In the hope of throwing light on this problem, Dr. H. S. Davis of the Bureau of Fisheries has taken a census of the fish in a small trout stream near the Holden, Vermont, experimental hatchery. "The stream selected for the purpose is a typical trout brook and, in the section where the fish were counted, flows through a pasture," he states. "The banks were over-grown with alders, interspersed with a few large trees. The stream has an average width of about 10 to 15 feet, with numerous small ponds 10 to 15 inches deep. The bottom has a gradual slope, over which the water flows in shallow riffles. The section in which the fish were counted has a total length of about 1,500 feet."

In counting the fish that were visible in the shallow water, every care was exercised to prevent counting the same ones twice.

Dr. Davis lists his count as follows: 53 brook-trout fingerlings, under 3 inches in length; 41 brook trout, 3 to 4 inches long; 70 brook trout, 4 to 6 inches long; 22 brook trout, 6 to 10 inches long.

The total number of brook trout counted was 186, which is at the rate of about 654 fish to the mile. In addition to the trout, there were 20 black-nose dace and 9 sculpins.

"There can be no doubt that the actual number of trout present was considerably greater than is indicated by the figures," Dr. Davis states, "since, in spite of every precaution, a number of fish hid under the over-hanging banks and in masses of debris before they could be counted. It is believed that at a conservative estimate not over 75 percent of the trout actually present were counted, and that an estimated trout population of 875 per mile would not be excessive."—*Science Service.*

* * *

Is Education Antiquated?

THE value of viewing the curriculum from the pupil's standpoint was pointed out by Dr. Jesse E. Adams of the University of Kentucky who addressed the American Association for the Advancement of Science at its recent annual meeting held at Philadelphia.

"It has begun to dawn upon us that the attitudes and ideals built up when pupils must take subjects they do not like may be far more detrimental than all the subject matter they get," he said.

"It would seem that those who are responsible for making our curriculums should be fully cognizant of how deadening failures are and to what extent forced interests burn the candle at both ends. I believe Otis Caldwell was quite right when he said: 'Pupils develop fastest when engaged most of their time upon things in which they succeed and not fail.'"

Dr. Adams' interest in the viewpoint of the students led him to make a survey of high school pupils in Kentucky. Five thousand pupils answered such questions as: "What were the subjects in which you failed? What subjects would you like taken out of the curriculum, and what subjects would you like to take that you cannot get?"

It was found that mathematics and Latin were responsible for far the greatest percentage of the failures. The difficulty and lack of practical application of these subjects made them very unpopular. Algebra, geometry and Latin were wanted out of the curriculum. Of the subjects which the pupils wanted to take and could not get, the girls agreed upon domestic science, French, Spanish, typewriting and bookkeeping, and the boys upon manual training, chemistry, typewriting and bookkeeping.—*Science Service.*

* * *

Great Lakes Area Being Uplifted

THE city of Buffalo is being uplifted at the rate of about half a foot a century, raising with it the water level of Lake Erie. How this is affecting the Great Lakes region was explained by Frank B. Taylor, geologist of Fort Wayne, Indiana, who recently spoke before the Geological Society of America. "Barring human interference, and supposing the rocksill at Buffalo to hold firm, Lake Erie would be raised to the level of Lake Huron, as it was before the present extreme low stage, in about 1,600 years," Mr. Taylor said. "In about 1,600 more years, the upper four lakes would discharge at Chicago, and Niagara Falls would go dry."

Engineers can hardly afford to overlook the natural changes in planning future works on the shores of these waters, he pointed out.—*Science Service.*

* * *

Eastern States Not Free from Earthquake Danger

PEOPLE in the region of Philadelphia who think that their homes are free from all earthquake danger because no destructive quake has occurred in the neighborhood in recent years need not feel entirely safe. For "the old ideas about regions of the earth's surface being 'free of earthquakes' may be regarded as either erroneous, or at least of a purely relative character," Dr. Frederick Ehrenfeld, professor of geology at the University of Pennsylvania, said before the meeting of the American Association for the Advancement of Science held recently in Philadelphia.

"The fact that within the short period of American Colonial and post-Revolutionary history there are very few evidences of earthquake movements in the Philadelphia area may mean no more than a period of quiescence in a latent earthquake zone," he said.

The geologic structure of the earth under the Philadelphia region, and especially the fact that it is located within an area less than two hundred miles wide from the seashore to the Blue Ridge and Allegheny Mountains, shows that there may be a strain in the region, and that earthquakes in this eastern section are easily possible.—*Science Service.*

* * *

American Boys Taller Than in Grandpa's Day

AMERICAN boys are taller by at least two inches than the youngsters of the same age were when grandpa was a boy. How this change in American stature has been measured was described by Dr. Horace Gray, of the Institute for Juvenile Research in Chicago, at a meeting of anthropologists of the American Association for the Advancement of Science.

Dr. Gray measured over 1,000 boys of American-born parents, between six and eighteen years, and compared their heights with those of boys measured 50 years ago by another scientist.

The apparent increasing height of succeeding generations in this country is attributed by Dr. Gray chiefly to the increasing knowledge of facts governing health and control of disease. Infantile diseases, which so frequently damage growth, are more under control than in the past, he pointed out. And scientists are rapidly learning facts about the part that vitamins and sunlight play in growth.

European people are showing a similar tendency to increased height, Dr. Gray said.—*Science Service.*

* * *

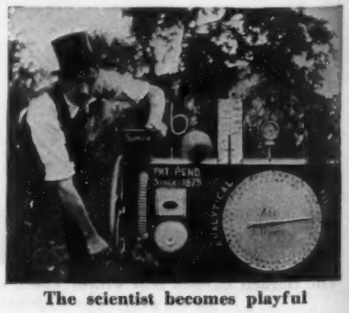
A Little Nonsense

THAT "a little nonsense now and then is relished by the best of men" is evident from the account of a recent meeting of the Western New York section of the American Chemical Society, in conjunction with the Niagara Section of the American Electrochemical Society, held at Niagara Falls.

At this meeting, according to the *Weekly News Edition of Industrial and Engineering Chemistry*, Dr. E. L. Whitford of the Oldbury Electrochemical Company, demonstrated an apparatus devised by his colleague, Dr. Prenert, which utilized the "cathode ray" to disintegrate, not merely a mouse, as described in the current popular press, but the cat that ate the mouse.

W. G. Harvey, American Magnesium Company, delivered an address on "Chemical Research in the Niagara District." Among other subjects treated, he announced that by co-operation between L. F. Hoyt and Raymond R. Ridgway a method of utilizing soapstone had been devised, the Larkin Company, Inc., extracting the soap and selling the porous stone residue to the Norton Company, manufacturers of abrasives.

R. B. MacMullin, Mathieson Alkali Company, demonstrated an analytical mill, patent pending since 1875, whereby any substance could be analyzed by a mere turn of the crank. Among other reports delivered by the machine during the demonstration was an analysis of a gold watch borrowed from Dr. Mortimer G. Brown of the Roessler & Hasslacher Company: Cu, 77.2 percent; Zn, 22.8 percent; Au, 00.00 percent. Ivory soap: Sodium stearate, 99.44 percent; sodium flotate, 0.56 percent.



The scientist becomes playful

The rise of John Blick—
an epic of success in business

JOHN BLICK
of Washington, D. C.

Some of his reflections on International Trucks

"I drove my first International myself for about five years and still have it running on its route.

"I know that I never lost a customer through the fault of my trucks. I now have at least 15,000 customers and 31 trucks, all Internationals.

"I have only one mechanic to keep all my trucks running. He has taught each driver to take good care of his truck."

FROM the wheel of his first International Truck to the Presidency of three corporations rated at over $3,000,000—in nine years—that has been the rise of John Blick.

In the Spring of 1918 a young man came to the International Truck dealer in Washington, D. C., with an idea and very little money. His reputation and ambition got a favorable hearing for the idea, which was that an International Truck plus Blick (the young man's name) would make a profitable go of the ice and coal business.

John Blick at once proved his idea sound. Before the summer was gone his first International had grown to be a fleet of four. Customers multiplied and routes were extended. A year or two later his rising business became the Terminal Ice and Fuel Company, and truck followed truck until the fleet numbered thirty-one.

Growing up in sight of the capitol dome at Washington, John Blick knew that every boy has his chance to be President of the United States. To him that was the symbol of Opportunity. He did not expect to be the one man in a hundred million but he did expect to succeed! Born with a will to tackle the job, *and leaning heavily on International Trucks*, his rise has been rapid and inspiring. Today, after nine years, John Blick gives International Trucks a liberal share of the credit.

Over the great expanse of America are ten thousand business successes that Internationals have helped to make. Many times Opportunity has come riding at the wheel of an International Truck. Bigger opportunities are still ahead for men and trucks. Whatever your field, so long as there is *hauling* in it, International Trucks will help you on to substantial fortune and success.

The International line includes the Special Delivery for loads up to ½ ton, 4 and 6-cylinder Speed Trucks of 1½-ton and 1½-ton sizes, Heavy-Duty Trucks ranging from 1½-ton to 5-ton sizes, Motor Coaches, and McCormick-Deering Industrial Tractors. Served by 125 Company-owned branches in the United States. Write for literature.

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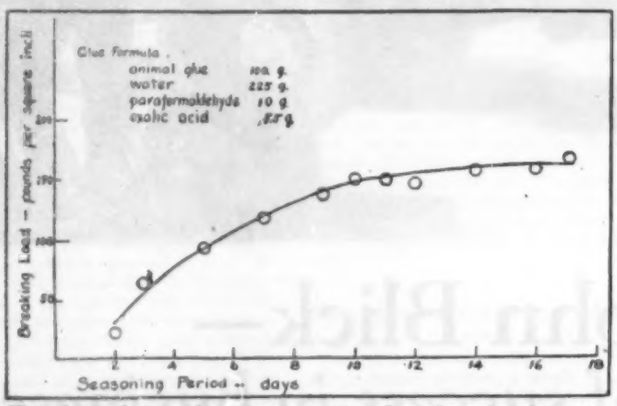
Water-resistant Animal Glue

A PRACTICABLE formula for a water-resistant animal glue has been worked out by F. L. Browne and C. E. Hrubesky of the Forest Products Laboratory, Madison, Wisconsin, and announced by them at a recent meeting of the American Chemical Society. The object of their investigation was to find a glue which would retain considerable strength when wet. At present it has been customary to use expensive casein glue for this purpose but it is believed that the formula given below will serve most ordinary purposes. If properly made this glue develops a dry strength of about 450 pounds per square inch in ply-wood tests and a wet strength of 110 to 160 pounds per square inch. In use, the glue develops its full strength only after a period of seasoning for seven or more days.



This chart of strength against seasoning shows how the glues containing paraformaldehyde developed their wet strength quite slowly

The glue is made according to the following formula:

	Parts by weight
*Animal glue	100
Water	225
Paraformaldehyde	10
Oxalic acid	5.5

*Equivalent to National Association of Glue Manufacturers' Grade 12 or 13, or to Peter Cooper's Grade I or IX. If a higher or lower grade of glue is used the proportion of water in the formula should be increased or decreased, accordingly.

Soak the glue in the water until the latter has been imbibed, then melt at 60 degrees, Centigrade. Lower the temperature to between 40 degrees and 45 degrees, Centigrade, and add the remaining ingredients. As soon as the oxalic acid dissolves, the glue is ready for use. Enough agitation must be provided to keep the paraformaldehyde in suspension—a condition which will probably be met by most glue spreaders. The working life of the glue at 40 degrees to 45 degrees, Centigrade, is from 7 to 9 hours if a suitable type of paraformaldehyde is employed. Joints made with this glue should be sufficiently water-resistant to meet requirements embodied in the Navy specifications for casein glue. In parallel-grain gluing with hard maple lumber the joints should be strong enough to tear the wood when tested to destruction.

The proportion of water used in this formula can be altered sufficiently to give any viscosity required for ordinary woodworking purposes.

In testing ply-wood panels made with animal glue containing paraformaldehyde for water resistance, it is imperative that a seasoning period of at least seven days, or preferably longer, be allowed after removing the panels from the press and before submitting specimens to the soaking test. As shown in the accompanying diagram, the full water resistance of the glued joints is not developed for many days, presumably because at room temperature the tanning of the glue by the paraformaldehyde, which gives this type of glue its strength, is a slow process.

Marking-Ink for Rubber

DIFFICULTIES in placing permanent marks on rubber for purposes of test or identification have led to the development of a mixture of lead chromate and glycerol for use on stamp pads. This type of ink, developed in the laboratory of the Philadelphia Rubber Works Company, Akron, Ohio, is readily prepared by adding a solution of potassium chromate to a solution of a soluble lead salt such as lead acetate, boiling the solution, filtering and grinding the nearly dry lead chromate in glycerol.

This ink gives permanent marks on rubber which are not affected by the ordinary treatment given rubber samples during laboratory tests. Hence it may be advantageously used for the marking of rubber articles where ordinary inks are useless. The imprints of this ink resist fire, steam and water as well as the ordinary destructive forces tending to destroy the rubber. In addition, they are not affected by the constituents of the rubber itself. Ordinary inks based on aniline colors are absorbed by the rubber and hence are not dependable. The mixture of lead chromate and glycerol tends to become hard on drying and should be kept moist by the addition of glycerol from time to time until used.

Rayon from Rice Hulls

THE demands of the growing rayon industry for cellulose, its principal raw material, are leading to searches for supplies in many fields. The most recent source of commercial cellulose is the rice industry of Louisiana. The hulls removed from the rice are now being used in a plant at Lake Charles, Louisiana, as a source of cellulose to be used in the manufacture of rayon. Silk that formerly came from the leaves of oriental mulberry trees, by way of the digestive system of the silk worm, is being largely replaced by rayon made in chemical plants from cotton, spruce trees and now from rice hulls.

Hydrogen as an Airship Fuel

SINCE the war, helium has largely replaced hydrogen as a lifting gas for airships because of the inflammability of hydrogen. However, recent tests made in London show that the very disadvantage of hydrogen as a lifting gas may make it important as an aviation fuel. Much difficulty has been met in balancing the loss of weight of an airship as its fuel supply is consumed. It is now proposed to use hydrogen to help keep the airship up when it is heavy with fuel and to burn it as the need for its lifting power decreases. The value of this lies in avoiding the waste which takes place when the lifting gas is released into the air to balance the loss of weight. The British experiments were carried out by burning hydrogen in a Diesel-type engine and have been quite successful.

As the supply of fuel is consumed by an airship in flight, a corresponding amount of hydrogen must be released. The experiments mentioned were undertaken to determine whether this waste hydrogen might be utilized to replace a portion of the oil fuel supplied to the engines. The maximum amount of hydrogen used in the experiments was slightly more than 3 percent by volume of the corresponding air supply at the lightest load, to approximately 14 percent by weight of the oil-fuel supply.

Three corresponding series of trials were also made, using coal gas in place of hydrogen. The maximum volume of gas used was 5 percent of the air supply, corresponding, at the lightest load, to about 24 times the weight of fuel oil used.

It was stated that these quantities of coal gas or hydrogen could be satisfactorily employed in the type of engine considered, and that the engine appeared to run more smoothly when the gas was being used.

Velocity Hastens Corrosion of Steel

THAT the velocity of water passing a piece of steel submerged in it affects the rate of corrosion has been the subject of considerable controversy among experts. A recent investigation carried out at the Massachusetts Institute of Technology showed that the presence or absence of rust on test specimens is of prime importance in determining the effect of velocity on corrosion. In reporting their results in *Industrial and Engineering Chemistry*, Messrs. Russell, Chappell and White state:

"Although the electrochemical character of corrosion is now almost universally recognized and accepted, a number of apparently discordant facts, difficult to explain along electrochemical lines, have been reported in the literature. Some of these supposed discrepancies have made it very difficult to arrive at an understanding of some phases of the mechanism of corrosion. For example, the experimental evidence in regard to the effect of velocity on the corrosion of steel by natural waters is very contradictory.

"It is clearly recognized that the corrosion of steel under natural waters is mainly dependent on two factors: (1) the degree of protectiveness of the film of corrosion products on the metal surface, and (2) the rate of oxygen diffusion to an active cathode area. In a given natural water—that is, under conditions where the degree of film protectiveness is constant—the rate of oxygen diffusion controls the rate of corrosion. It would be expected, therefore, that an increase in the velocity of water past a corroding steel surface would result in an increase in the corrosion rate, since the oxygen diffusion would be increased by virtue of the thinning down of the layer of relatively quiet liquid against the metal surface."

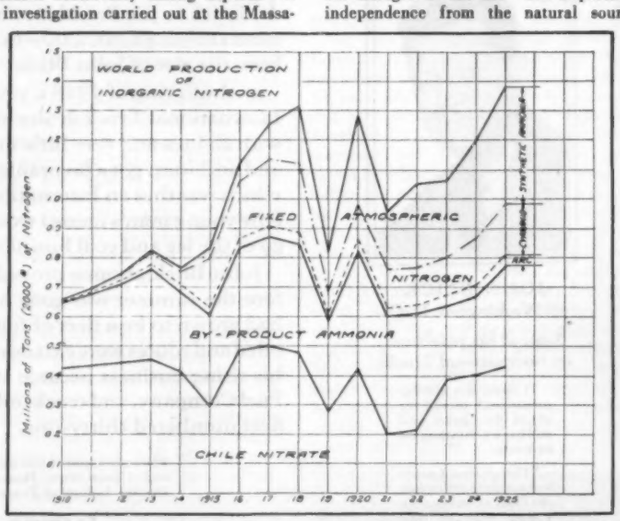
The investigators carried out tests on pieces of rough steel, polished steel and steel coated with a uniform rust-film, immersed in water whose velocity when flowing over the specimens varied up to seven feet per second. They state the following conclusions:

"1—The corrosion of steel under water increases with increasing water velocity over the range commonly encountered in practice, providing the metal is coated with rust.

"2—By suitably altering the surface condition of steel, it is possible to reproduce the apparently conflicting data which previously have appeared in the literature concerning the effect of water velocity on the corrosion of submerged steel."

Nitrogen Fixation

DURING the war much attention was paid to the synthesis of ammonia from the nitrogen of the air. The importance of independence from the natural source of combined nitrogen in Chile was only realized when there were threats of cutting off that supply. More than 25 years ago Sir William Crookes gave out his warning of the possibility of the world facing ultimate starvation "within a comparatively limited time" because of the exhaustion of the natural niter beds of Chile. A recent survey by Ernst and Sherman of the Fixed Nitrogen Research Laboratory of the Bureau of Soils, published in *Industrial and Engineering Chemistry*, shows that within



This chart shows the fixed nitrogen production from Chile, from by-product ammonia from coke ovens and that obtained from the air

25 years "the world has changed from practically 100 percent dependency upon Chile for its inorganic nitrogen supply to 30 percent dependency."

The importance of nitrogen in combined form is only realized when it is needed for explosives in war or for fertilizer to increase the yields of agriculture. We often read that such and such a person or firm is about to "manufacture" nitrogen or "make synthetic nitrogen," which, of course, are errors, for no one has yet been able to create matter. The essential thing is to force the nitrogen of the air to combine into useful chemical compounds. Atmospheric nitrogen is quite useless to either the explosive maker or the farmer until it can be forced to combine with hydrogen or oxygen to form ammonia or nitrates. When it is thus combined it becomes quite invaluable to both, for either ammonia or nitric acid will serve the farmer and ammonia can be converted into nitric acid required by the explosive maker.

The synthesis of ammonia by various processes is rapidly gaining ground in the United States and at the present time we have a potential capacity for ammonia synthesis equivalent to 30,330 tons of nitrogen per year. A recent announcement by the Allied Chemical and Dye Corporation states that this firm is about to build a new large-capacity plant at Hopewell, Virginia, as a result of large-scale experiments on the development of a satisfactory process. The industry of synthetic ammonia is growing rapidly both in the United States and abroad.

In addition to the natural niter deposits in Chile, the by-product coke ovens of the world are also producing immense quantities of ammonia for agricultural use. In the United States in 1925 there was produced ammonia from coke ovens equivalent to 123,600 tons of nitrogen.

Crank-Case Corrosion

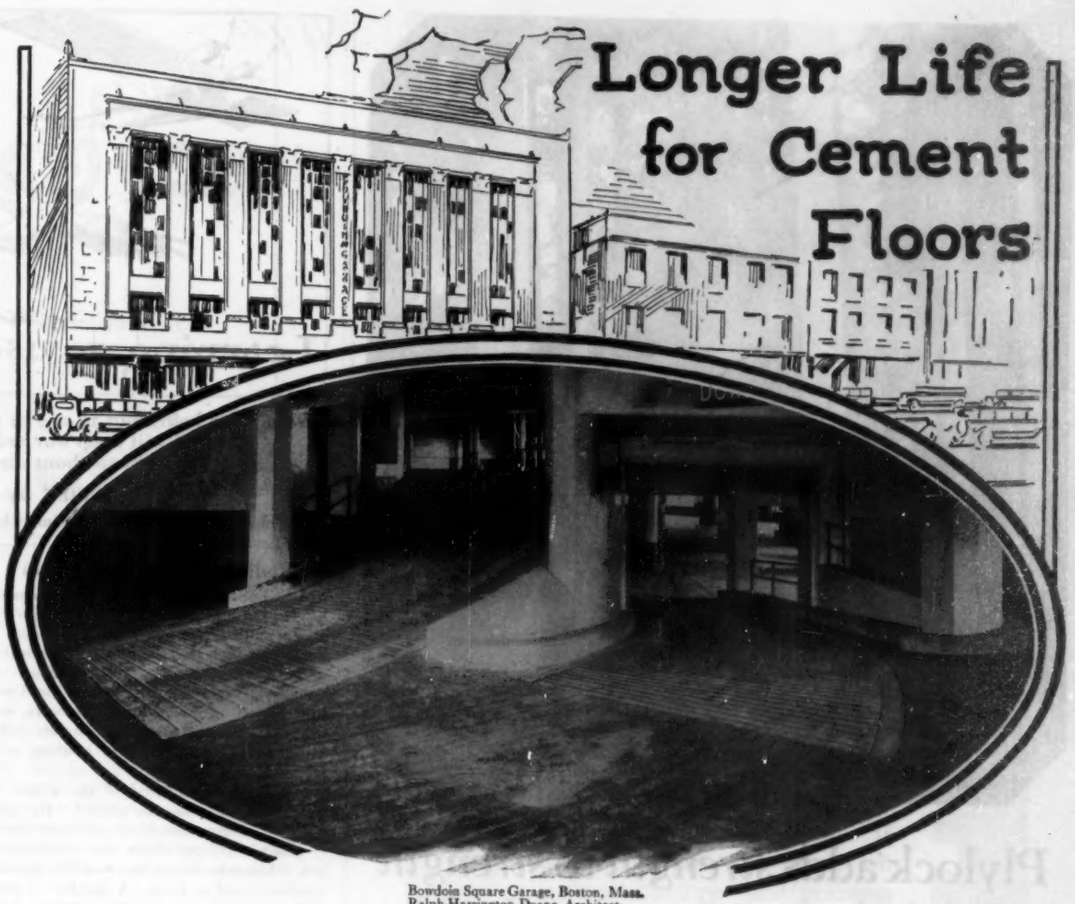
FIFTY million dollars worth of gasoline a year might be saved to the country if it were possible to tolerate a higher percentage of sulphur in the fuel of our automobiles. In discussing the situation, H. E. Howe, in *Industrial and Engineering Chemistry*, points out that the methods now employed to refine gasoline to reduce the sulphur content to a satisfactory minimum also remove valuable elements of the fuel. The present necessity for keeping the sulphur in fuel low is that it is known to have a vigorous action in promoting corrosion of engine parts. Proper ventilation of the crank case will reduce this danger to some extent but no method for its complete elimination has yet been found. In summing up, Mr. Howe says, in part:

"The automotive engineer has made a distinct contribution toward realizing this saving of fifty million dollars a year, but millions of cars in the hands of the public are not equipped with the newest devices and, indeed, the improvements are too new to enable manufacturers to include them in all makes of cars.

"The problem therefore is an active one. The chemist is still called upon to find better and more economical ways of removing this sulphur, while the automotive engineer proceeds as rapidly as possible to equip cars with the means for removing sulphur dioxide, sulphur trioxide, and water, formed when a motor fuel high in sulphur is employed.

"There is no thought that the designers of automotive engines should provide devices to enable the individual owner to correct a lack of proper refining, nor should the engineer stand by and impose upon the chemist and the refiner unnecessary conditions resulting in a considerable loss of an irreplaceable fuel. It is another invitation to cooperation, with the public the eventual beneficiary."

The possibilities in this field are enticing, particularly in view of the prodigious rate at which petroleum is being consumed in automobiles. And the reward is fifty million dollars a year!



Bowdoin Square Garage, Boston, Mass.
Ralph Harrington Doane, Architect
Chase & Gilbert, General Contractors

THE ramps in this garage—one of Boston's newest and finest—have been made both slip-proof and durable by using Alundum Aggregates in the cement. And the slip-proof feature is not affected by water and oil. The aggregates have also been used in the treads of the main stairway.

Alundum Aggregates are a semi-vitreous product made by bonding hard, tough Alundum abrasive with clay. Their slightly porous structure causes them to bond perfectly with cement, becoming an integral and permanent part of the floor. The result is a walking and trucking surface that combines exceptional resistance to wear with slip-proof effectiveness.

Alundum Cement Floor [C.F.] Aggregates are marketed in two sizes—the coarse (.295"—.100") for the finish course or topping and the fine (.100"—.0322") for surface treatment only.

Alundum Aggregates for terrazzo floors are marketed in four sizes and five colors.

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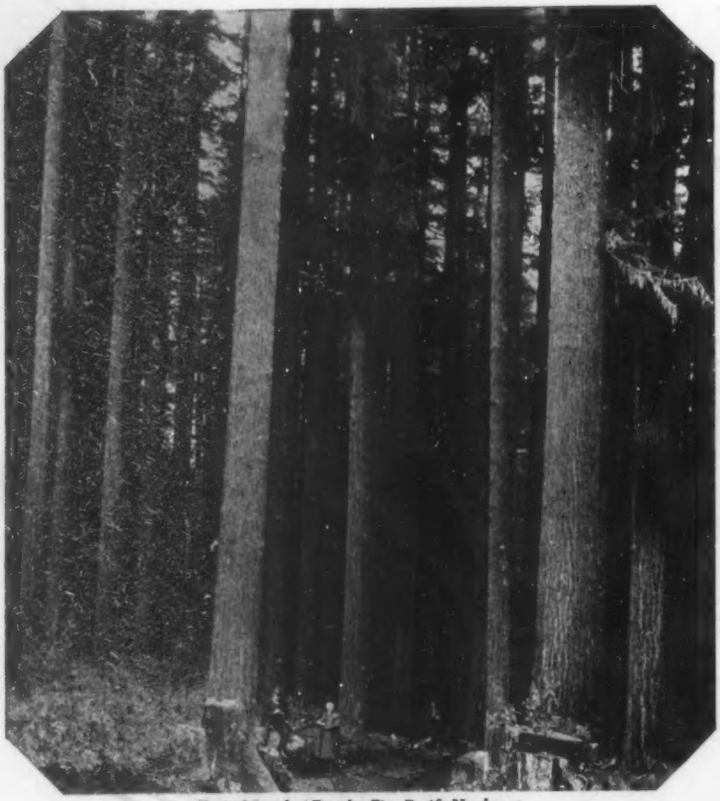

Typical Stand of Douglas Firs, Pacific Northwest

Plylock adds *strength* to *strength*

"Douglas fir is the strongest resinous wood, pound for pound, that has ever been tested," says Prof. Grondal, of the School of Forestry, University of Washington.

Plylock, made from selected thin veneers of Douglas fir, permanently cemented together, with the grains of alternate plies running at right angles to each other, possesses strength and permanence tremendously greater than solid fir—greater, in fact, than that of many hardwoods. Moreover, its laminated construction makes it proof against warping and splitting.

"Wood that's stronger than wood" is being used in many important industries. Manufacturers of automobile bodies, trunks and cases, doors, cabinets and interior woodwork, toys and novelties, desks and furniture, and of many other articles have adopted Plylock to improve quality and cut material and labor expense.

Full size sample of Plylock will gladly be sent you for experimental and development work in your own factory, and our research department is at your service.

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Plywood makers for 27 years.

PLYLOCK
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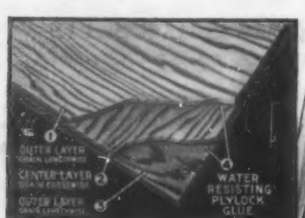

3-ply Plylock cut away to show construction. Plylock is regularly made in 3 and 5 plies of finest Douglas Fir.

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Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

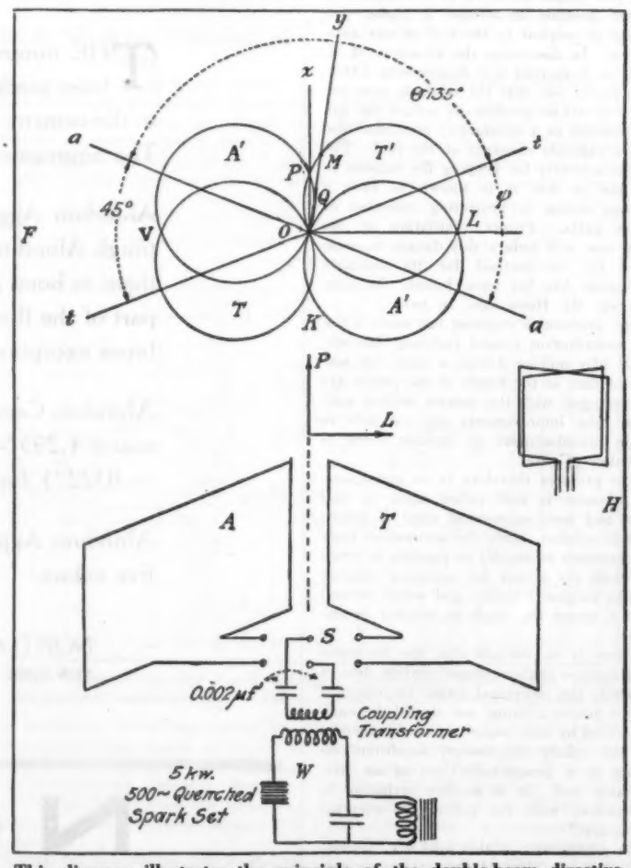
In charge, Daniel Guggenheim School of Aeronautics, New York University

Radio in Aerial Navigation

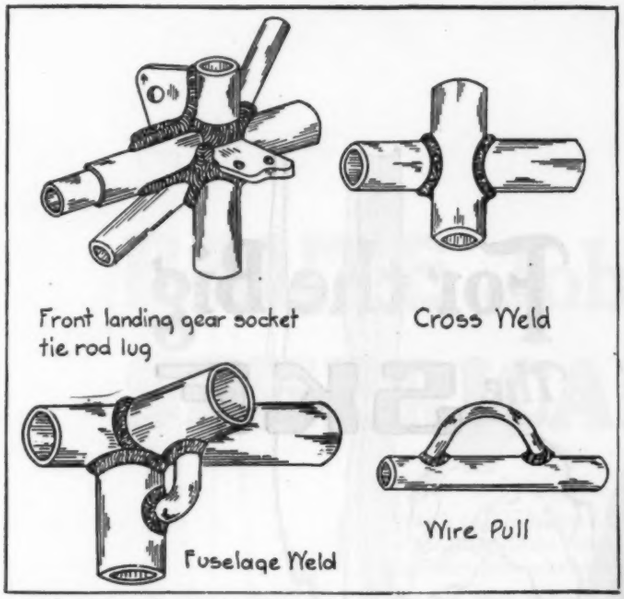
SUCCESSFUL air navigation depends largely on the use of radio aids. No single radio system will suffice however; a number of such devices must be coordinated to the same end. Dr. J. H. Dellinger, in a masterly paper presented before the American Society of Mechanical Engineers, sets forth the present status of aircraft radio and the many problems still awaiting solution.

The most urgent need of the aviator is communication from the ground. He must have the cooperation of an adequate system of ground stations which can telephone to him information regarding weather, landing conditions and so forth. A number of practical receiving sets for the airplane have been developed which are both light and simple, but there remain many problems to be solved. These include such items as choice of sets, type of power for transmitting, the assignments of frequencies, and above all the shielding of the receiving set from the influence of the ignition system.

Ordinary communication from the ground is not sufficient however. Particularly when the ground is obscured by fog, or when flying at great altitudes, the directive radio-beacon must be employed. In marine navigation it is possible to use direction finders, with a species of "wireless sighting" on two land stations. On account of weight limitations of the airplane, however, it is important that nothing be carried aboard other than the receiving set provided for communication. Therefore the radio beacon, developed in its most promising form by the Army Air Corps and the Bureau of Standards is the logical solution.



This diagram illustrates the principle of the double-beam directive aircraft beacon. In the upper part of the diagram, the *A'*, *T*, and *T'* circles show the relative intensities of radiation from each transmitting coil in all directions. On the line *OX*, the intensities from the two coils are equal. Therefore, the aviator flies on this line



Typical steel welds in modern aircraft fuselage construction

This beacon sends out two directed radio-beams, continuously transmitting a characteristic signal on each of the two beams. If the pilot departs from the line situated half-way between the two transmitting coils, he will hear the signal sent out from one coil much more distinctly than that from the other. By flying so that the signals are heard with equal intensity, he can keep very closely to the proper route between two airports.

The aural method is acceptable to pilots, although it is sometimes difficult to distinguish between the two signals because of the inevitable background of noises of various descriptions. If a visual indicator could be developed to work in conjunction with the radio beacon, the pilot's task would be greatly simplified.

The problem of the radio beacon will become more complicated when there are several routes starting from the same airport. It will then be necessary to rotate the coils and the so-called "equi-signal zone" in steps, setting it for brief periods on the several courses desired. A nice problem, both in radio and in mechanics, arises therefrom.

The radio beacon tells the pilot whether he is on the right route or not, but not how far he is along the route. This lack can be remedied by a species of radio "milestones." These consist of very low-power radio transmitting stations, non-directional in character, set at intermediate points along the route and serving as markers or localizers.

Granted that the radio beacon and the makers will guide the pilot successfully along his route, there still remains the problem of landing in a fog. A number of electrical field-localizers have been developed in recent years but without definite practical application. The Army Air Corps, among other organizations, has been experimenting with an apparatus in which a coil of wire carrying a 500-cycle alternating current has been placed around the confines of the landing field. Using an amplifier, the aviator can, by flying experimentally over the area, pick out the center of the field quite accurately.

But even a good field localizer is insufficient in itself. The pilot must know not only when he is over the center of the field, but exactly how high he is above the field, particularly when at an altitude of less than 100 feet. The most promising system involves the use of electrostatic capacity and was described in detail in our December issue.

Adjustable Rudder Bar

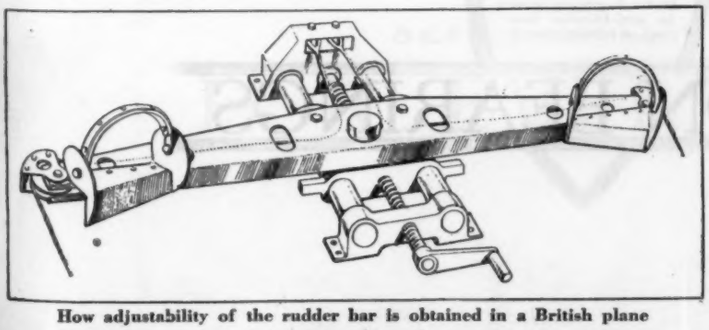
IT is quite a problem to accommodate pilots of different heights in the same cockpit, and have them sit comfortably in relation to the rudder bar. In the Blackburn *Sprat*, an English seaplane described in *Flight*, the rudder bar is made adjustable by the simple process of shifting the pivot point about which the rudder bar hinges. This is achieved by a screw thread and a crank as shown in the diagram. At the same time the rudder cables are so attached in the system that the tension on them remains the same in every position.

Welding Metal Fuselages

TO read that the fuselage of an American-built plane is made of welded steel tubing is commonplace. But it took many years of patient development before this method of construction could be regarded as successful. S. Daniels, in a paper delivered before the American Society of Mechanical Engineers, discusses materials, methods and difficulties involved.

Arc welding of fuselages is still in the experimental stage and seems to require too great a degree of skill to make it practical. Gas welding is invariably employed today. In this process, the flame, formed by burning a mixture of oxygen and acetylene,

(Continued on page 280)



How adjustability of the rudder bar is obtained in a British plane

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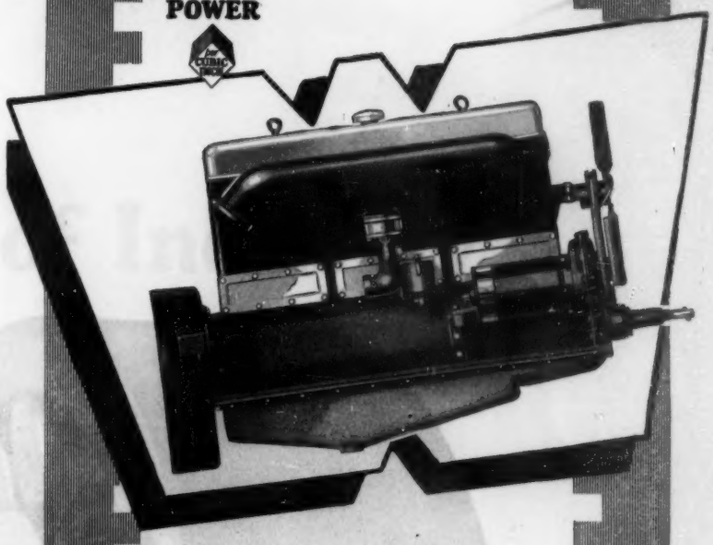

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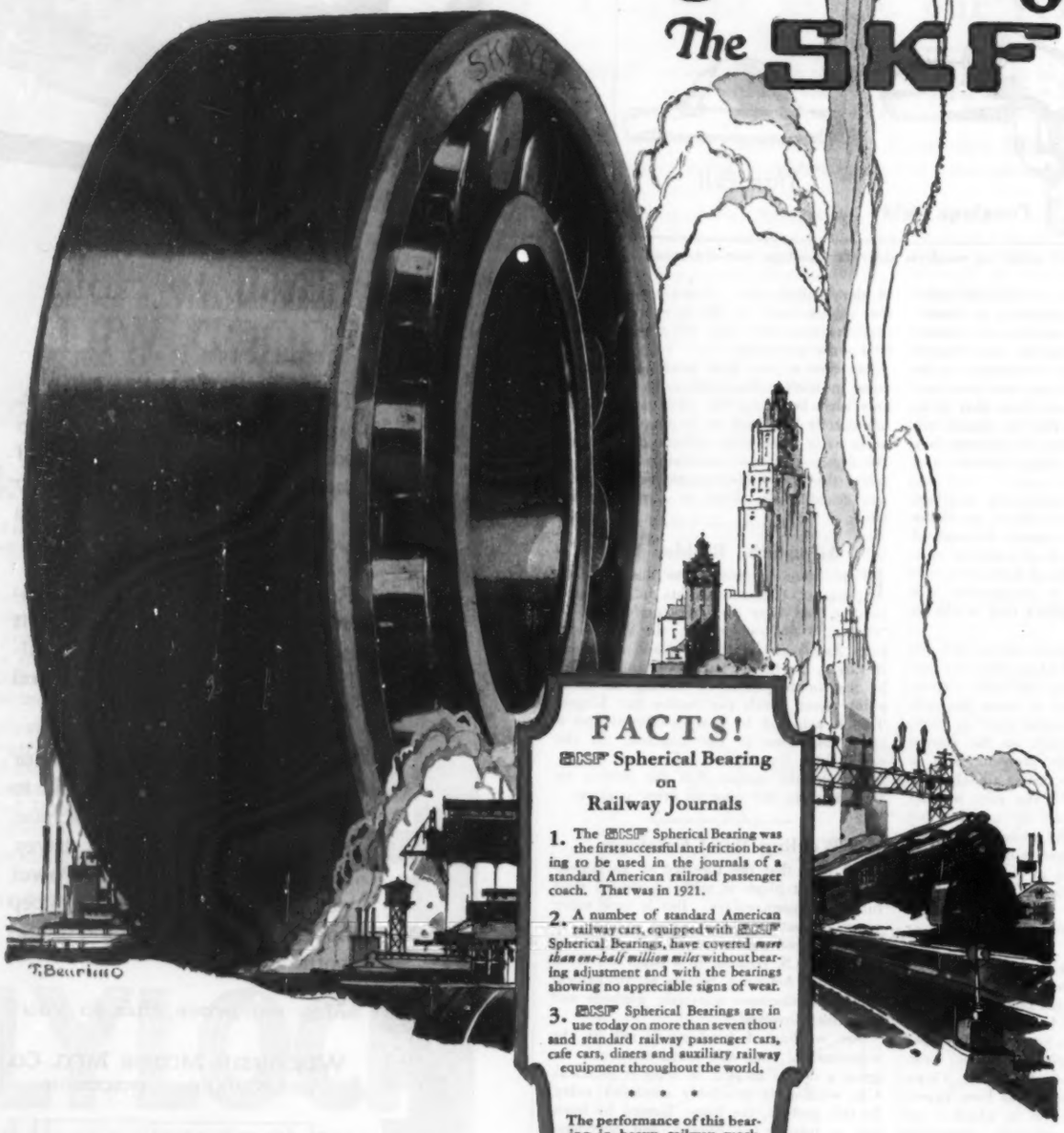

FACTS!

SKF Spherical Bearing on Railway Journals

1. The SKF Spherical Bearing was the first successful anti-friction bearing to be used in the journals of a standard American railroad passenger coach. That was in 1921.

2. A number of standard American railway cars, equipped with SKF Spherical Bearings, have covered *more than one-half million miles* without bearing adjustment and with the bearings showing no appreciable signs of wear.

3. SKF Spherical Bearings are in use today on more than seven thousand standard railway passenger cars, cafe cars, diners and auxiliary railway equipment throughout the world.

* * *

The performance of this bearing in heavy railway work over a long period of years is the thing which is responsible for the present interest in anti-friction bearings on railway journals.

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On the great bulking monsters that grind the pulpwood that gives us our daily newspapers.

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These are the jobs on which this SKF Spherical Bearing has been functioning for years—the jobs on which its stamina, its ability to take punishment have been proved!

The SKF Spherical Bearing is not a new bearing. SKF would not endorse it if it was. It is time-tested. It has been used for years in the journals of standard American railway passenger coaches. The railway journal application of anti-friction bearings considered, at one time, the supreme test of bearing stamina is far from representing the maximum of punishment that this bearing will take.

But, lately, industry has discovered in this bearing qualities that no other anti-friction bearing possesses.

It is the only heavy-duty roller bearing that approaches the anti-friction qualities of the ball bearing.

It is practically the only roller bearing ever produced for combined radial and thrust load that is made as well as a ball bearing is made, from the standpoint of materials, workmanship and finish.

And, so, SKF offers this bearing to industry for any job that is worthy of its steel—for the big job—the brute job. For, this bearing, alone, has proved that it could *stand up* not in the laboratory, not on paper, but through years of actual gruelling service under conditions that caused all other bearings to fall down.

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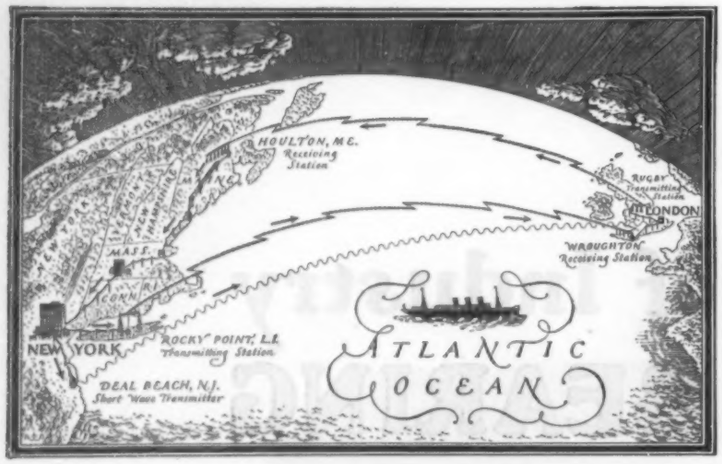

The Radiophone's Meaning

An Advertisement of
the American Telephone and Telegraph Company

AN ADVENTURE in communication was made last January when transatlantic radio telephone service was established between New York and London. There had been previous tests and demonstrations. Nevertheless, the fact that at certain hours daily this service was made available to anyone in these cities from his own telephone, created such public interest that for several days the demands for overseas connections exceeded the capacity of the service.

It was then demonstrated that there was a real use for telephone communication between the world's two greatest cities. It was further demonstrated that the American Telephone and Telegraph Company, with the co-operation of the British Post Office, was able to give excellent transmission of speech under ordinary atmospheric conditions.

In accord with announcements made at that time, there will be a continued effort to improve the service, extend it to greater areas and insure a greater degree of privacy.

It is true that static will at times cause breaks in the ether circuit, but a long step forward has been made towards international telephone communication and more intimate relationship between the United States and Great Britain.

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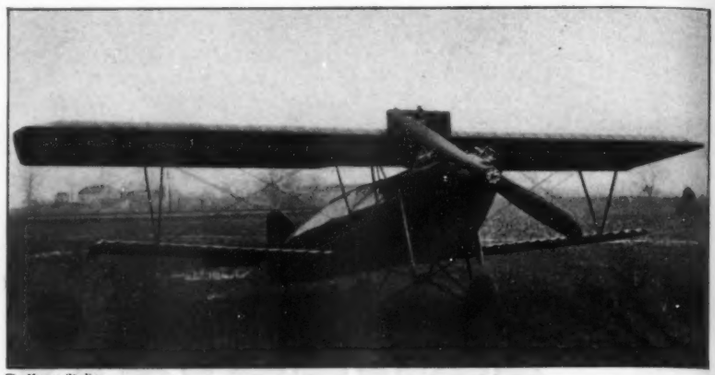


The Mercer Studio
The Kentucky Cardinal, built at Owensboro, Kentucky, is a promising type of plane for cross-country travel

fuses together a welding wire or rod and the edges of the parts to be joined. The welding rod is of soft steel containing a little carbon, manganese, sulphur, phosphorus and silicon.

At first, only plain carbon-steel tubing with a strength of 55,000 pounds per square inch was employed for welded-steel fuselages, which, owing to their size, cannot be heat treated after welding. Now the process has been successfully extended to chrome-molybdenum steels having an ultimate strength of 95,000 pounds per square inch in tension. Chrome-molybdenum cannot only be welded successfully without showing signs of cracking but can also be drawn to large diameters and thin walls, which gives great strength with low weight.

Tubing with wall thickness as low as .035 of an inch is used in fuselages, and in some less important parts the wall thickness may be as low as .022 of an inch. In simple tension, a welded joint has an efficiency of 100 percent of the original stock for chrome-molybdenum, and 80 percent for carbon steel.

However, the welded joint is not as strong as the original stock where bending stresses and shocks are to be resisted. Therefore, the designer has to exercise much judgment in deciding what sizes of tubing to use. With due allowance made for such stresses, however, welded-tubing fuselages can be used with the utmost satisfaction.

That construction is greatly simplified by welding is evident from the fact that at some points, such as where the landing gear attaches to the fuselage, six or more parts may have to be joined together. Without welding, there is an uncomfortable problem in fastenings involved.

The Kentucky Cardinal

UNDER the above picturesque name, the Kentucky Aircraft Corporation has produced a small plane for long cross-country flights, which embodies many principles of modern design, and is likely to have a decided appeal to the private owner as well as to the commercial operator.

In small planes designed for fairly long cross-country use, the question of baggage placement has been given little consideration. In the Kentucky Cardinal, a six cubic-foot baggage compartment has been provided, placed almost exactly at the center of gravity of the airplane, so that longitudinal balance is not affected by the presence or absence of baggage.

As long as the controls are effective, and the height above the ground is appreciable, a good pilot rarely fears an abnormal flight condition. To be sure of the controls, the cables and pulleys for both ailerons and elevators are replaced by rods, which give a more positive and reliable system, even if they are a little heavier than cables.

When an aileron is pulled down, the lift is increased on the same side, but so also is the drag. At the same time, the aileron on the other side is pulled up, and the lift there diminishes, but the drag either diminishes or increases slightly. Therefore the ordinary aileron system provides effective rolling moment, but at the same time introduces a tendency to swing the airplane off its course. This is particularly undesirable at slow speed and high angle of incidence.

The Cardinal has adopted a differential aileron control, whereby the aileron going up moves faster than the aileron going down. The rolling moment is as effective as ever, but the drags on the two ailerons are equalized and not so much effort with the rudder is needed to counteract the ailerons. This is particularly valuable at the "stall" point.

A biplane offers certain structural advantages over the monoplane, but the lower wing has a tendency to impede the pilot's vision on landing. In the design of the Cardinal, there is a happy compromise; the biplane structure is retained, but the chord of the lower wing is much less than that of the upper wing.

The fuselage is another example of what is now almost universal practice, being built of welded steel-tubing, providing the maximum safety in a crash and needing no adjustment in the field.

The tank and radiator are both placed at the upper wing, providing gravity feed for water and gasoline systems. The entire engine cowling can be removed in eleven seconds.

With the OX-5, 90-horsepower engine, the plane is quoted by the manufacturer as having a speed of over 100 miles per hour, and a climb of 11,000 feet in only 23 minutes.

An Airship Competition

CONGRESS has authorized the construction of two giant airships, but has not as yet provided funds. There is a vast difference between the two situations. The Navy has funds for a 50,000 dollar airship-design competition, the designs to be in by midnight May 16, 1927, but "a way to contract authorization is expected by the time this competition is ended."

The material sent in to the Navy must not embody just an idea. The rules state that sufficient drawings and calculations must be submitted to permit intelligent analysis and appreciation of the structure.

A consideration of factors relating to facilities and financial ability to construct the newly designed ship will be an essential feature of the granting of building contracts. For the gaining of design awards, excellency of design alone will be the criterion.

Percentage ratings are assigned on the following basis: Ratio of gas volume to weight when empty, 15 percent; ratio of gas volume to air volume, 5 percent; factor of safety in heavy and light conditions, with a 2.5 minimum, 5 percent; factor of safety in extreme conditions, also with a 2.5 minimum, 5 percent; cruising radius at full power and at 50 knots, 15 percent; maximum speed at 3,000 feet altitude, 10 percent; endurance of power plant and facility of attendance in flight, 5 percent; accessibility of structure and gas compartments in flight, 5 percent; economy of construction and facility of repair, 5 percent;

subdivision of gas space, 5 percent; economy of buoyant gas in respect to leakage and valving, 5 percent; ease of aerodynamic control, 5 percent; facility of mooring, landing and handling on the ground, 5 percent; safety from fire and other accidents, 5 percent; refinement of detail, 5 percent.

The Navy has adopted a very broad-minded attitude in setting forth the rules of the competition. *It is not intended to restrict competitors to the so-called conventional type.* Provided certain definite requirements are met, competitors are free to submit any type of airship structure and any type of airship operation. Free scope is thus given to design and inventive ability.

There must be certain essential characteristics. A weight of 10,000 pounds equally distributed along the middle two-thirds of the airship must be allowed for military equipment. The airship must be adapted for carrying several airplanes and for attaching and detaching them while in flight. There must be a large radius of action. There must be maximum freedom from fuel hazard, and while the use of helium is contemplated, hydrogen gas or a combination of hydrogen gas with helium may be substituted. (This means adequate interior ventilation and perhaps the use of an outer shell of helium as a guard.)

The useful load and performance requirements have been worked out by the Navy with the utmost care. They are a trustworthy guide to what may be expected today of an airship of the size called for. The latter specifications are: 6,500,000 cubic-feet gas volume; a length overall of not more than 780 feet; an overall height of 155 feet, and an overall width of not more than 135 feet. The gross lift should be about 40,000 pounds and the useful lift about 19,200 pounds. The maximum speed should be at least 70 knots, or some 81 miles per hour. The range should be at least 7,500 miles, starting with not more than 70 percent of the useful load in fuel and oil.

The lifting gas is to be subdivided into many containers, with not more than one-eighth of the total volume in any one container. The number of engines is not to exceed 12, nor be less than four. The gas-pressure system, officers' and crews' quarters, control cabin, leakproof qualities of gas bags, properties of the outer cover and many other items are adequately covered in the competition rules.

All these requirements call for ingenuity and inventive ability. There are certain clauses in particular which call for radical departures from convention. Thus, the outer cover may be utilized as a strength member of the airship. (Presumably it will be of metal, as in Upson's design.) Power-plant arrangements include provision for quick starting of each engine, for disengaging each propeller and locking it in position, and for quickly reversing the thrust.

A method of obtaining vertical thrust either up or down is considered desirable, for reasons often pointed out in these columns. Water-recovery apparatus weighing not more than 0.75 pounds per horsepower is stipulated as being desirable. Special consideration must be given to the problem of mooring an airship and for handling on the ground—a fruitful field for innovations. The use of helium largely eliminates the fire danger, so that it is considered safe and desirable to place the engines within the hull of the ship, provided a reliable drive from the engines to the propeller is employed.

Here is a vast effort to be undertaken. Each aspect of the design bristles with problems requiring both theoretical analysis and skilful engineering and, if possible, experimental work.

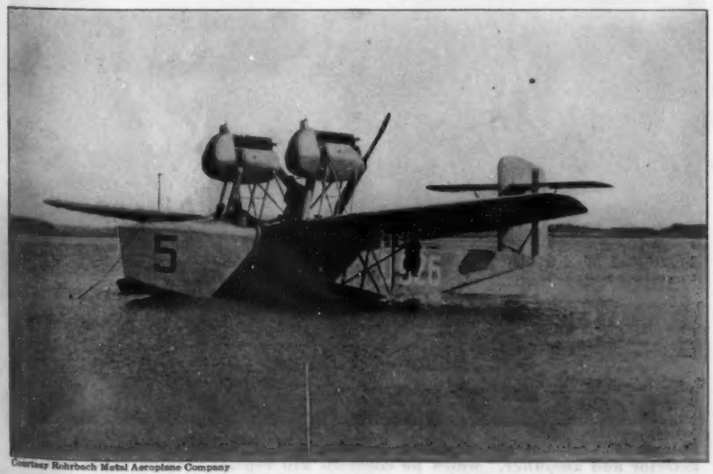
How Many Floats?

IN a paper presented before the Society of Naval Architects and Marine Engineers, Captain Holden C. Richardson reviews the entire subject of naval development of floats for aircraft. An important topic discussed is that of the number of floats which is most effective for the average seaplane. Twin floats are objected to on several counts.

For the same buoyancy, two floats are heavier, require stronger supporting members and present more air resistance than single floats, even when the latter are combined with tip floats. In a "cross chop," there is a strong racking and weaving effect which necessitates a more rugged fuselage and wing-root construction than is the case with central floats. When "taxying" on the water, twin floats do not steer as well as single floats. If one twin float touches before the other on landing, the latter is made to land harder. With twin floats, a 90 or 100 percent reserve of buoyancy is required. With single floats an 80 percent reserve is adequate; thus the single float can be made relatively smaller and lighter. Instead of imposing additional strains on the fuselage, the structure of the single float may be made to reinforce it.

For torpedo and bombing planes, the twin float arrangement nevertheless offers the best all-around solution for obvious reasons. The central float also presents difficulties from the point of view of lateral stability. These are usually met by using tip floats, located near the tips of the wings as their name implies, and in such fashion that they are clear of the surface normally. As a consequence, when the plane is "heeled over," one float is immersed and the other is above water. The only righting effect is that due to the buoyancy of the immersed float and there is no initial stability due to the tip-float disposition.

Now, recourse is had to the triple float which is shown in the accompanying photograph of a Rohrbach seaplane. In the triple float, both side floats are first immersed and develop buoyancy, thus assisting the main float and also providing initial stability. Also, when the plane is "heeled," both floats aid in providing a righting couple until the plane comes clear.



Courtesy Rohrbach Metal Aeroplane Company

Triple floats are used in this new type of seaplane mentioned above

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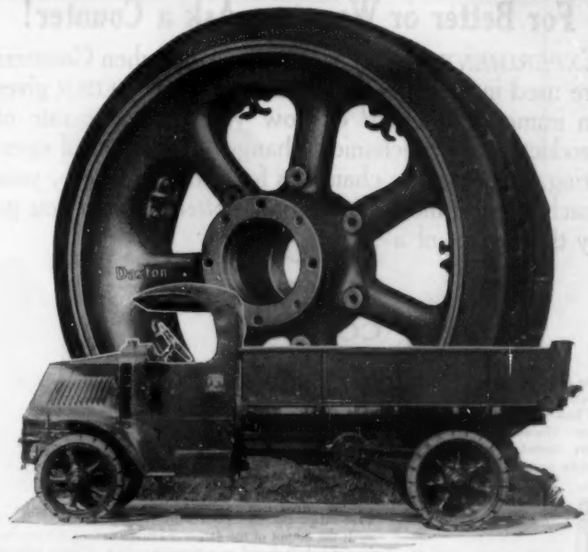

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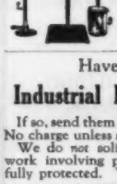
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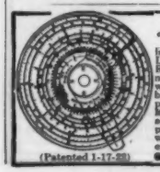
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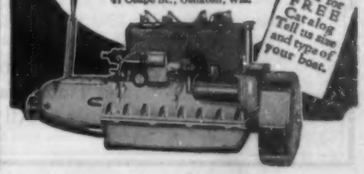
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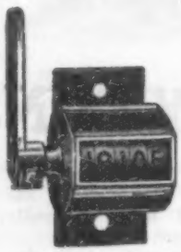
The large Set-Back Revolution Counter at right is less than ¼ actual size. The small Revolution Counter below is shown nearly full size.



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Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.

Televisor "Sees" in Darkness

THE sensitive "eye" of John Baird's televisor in England has now been developed to a stage where it can "see" in the dark. In the early experiments with the televisor, the image to be transmitted, whether of a person or an object, had to be placed under an intense light so that sufficient brilliancy could be reflected to a sensitive photo-electric cell. Today, however, the televisor can "see" in total darkness, by "illuminating" the object, the image of which is to be broadcast, with waves of light outside the visible spectrum, that is, those just beyond the red and violet light-rays.

The waves employed are those of the infra-red band, which are vibrations in the band between light and heat waves. The infra-red rays are directed upon the image or object by applying powerful white lights to color filters which sift out all vibrations except the infra-red. While the human eye cannot detect these rays, the photo-electric cell has no difficulty in "seeing" them. One difficulty has arisen, however, in the fact that the infra-red rays tend to distort the image slightly because the photo-electric cell will not respond to all the colors of the object when it is submitted only to infra-red light.

Inventor Baird has also experimented with ultra-violet rays but they, when used on persons, cause the party whose image is being broadcast to complain of sore eyes and headaches.

A New Detector

A RADIO invention, said to be of a revolutionary nature, has been announced by Dr. Palmer H. Craig, head of the physics department of Mercer University, at Macon, Georgia, who contends that the device is likely to dispense with vacuum tubes and batteries in radio receivers.

The instrument consists of plates of bismuth surrounded by a coil of insulated wire. When electricity passes through the wire a field of magnetic force is created, which causes the bismuth to become active either as a detector or amplifier. A coating of sulphur is used to protect the bismuth from the atmosphere.

Dr. Craig points out that a radio circuit in which this device is employed requires no current for operation except the received Hertzian waves. He reports that laboratory experiments indicate that the device is four or five times more sensitive than an eight-tube receiver, and as a detector it is even better, because it eliminates much of the distortion which is likely to occur with some tubes.

The process is described as follows: It is an application of the Hall effect as a method of rectification of alternating current, similar to that described by Descoudres.

Dr. Alfred N. Goldsmith, when asked for his opinion on the practical importance of the Craig invention, said: "The Hall effect would produce a low power-output, or a second-order effect. For example, if we combine hydrogen and oxygen it produces water and is known as a first-order effect, because it produces a very important result. The Hall effect is a very curious magnetic action. It is entirely conceivable that electrons can be controlled outside a vacuum tube just as between a filament and metal plate inside vacuum-tube detectors and amplifiers. However, I am doubtful whether Dr. Craig's invention can produce an output equivalent to that of the modern vacuum tube."

Practical Hints on Radio Talks

THE possibilities of radio are beyond the conception of the average individual, according to Sidney W. Ashe, head of the Welfare Department of the General Electric Company, in a recent talk to the members of the Kiwanis Club in Springfield, Massachusetts.

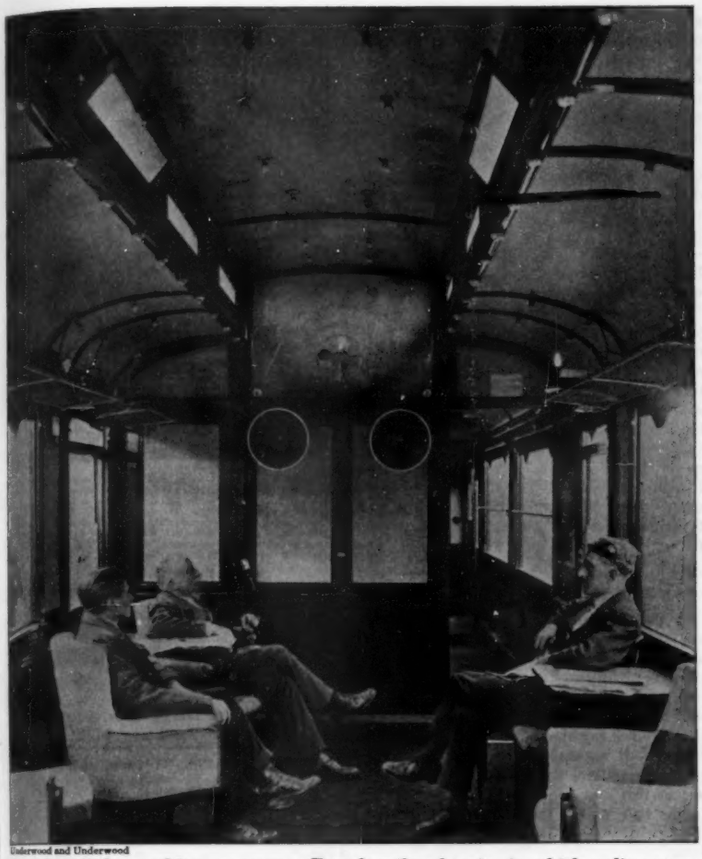
"Can you imagine the feeling of responsibility that comes over a radio speaker in the preparation of a talk when he knows that if the weather conditions are ideal and if his talk is to be sent out on short-wave transmission as well as the regular transmission, his voice will be heard over an area equal to nearly one-third the earth's surface? You can readily understand, therefore, why some amateurs like myself find it necessary to devote fully 200 hours to the preparation of one little talk, which will be transmitted in about 12 minutes.

"The talk must be interesting, must contain human interest experiences, must teem with life, must awaken your sympathies, must have no unnecessary words, and must roll along easily and smoothly.

Radio broadcasts not only your spoken

Underwood and Underwood

Palmer H. Craig, of the Mercer University, with his so-called "electro-magnetic detector and amplifier," which he contends will replace vacuum tubes and batteries. The device uses the principle of the Hall effect



Underwood and Underwood

Interior of the smoking room on a French railroad train, in which radio entertains the passengers. Note the two loudspeakers

word but your personality as well. Suppose you ask someone to read a poem and then you read aloud a similar poem to him, giving proper emphasis where needed. I think you will find that the poem as you read it is fully five times as effective as the read poem, and if a third poem of similar nature is listened to over the radio as read by a professional announcer where the radio adds its power or strength to it, I am wondering whether you will not find that it is fully ten times as effective as the poem read aloud.

"In other words, from my own observation it would seem that the message as received over the radio was fully 50 times as effective for popular material as reading it. This probably explains why an advertiser is willing to pay 500 dollars an hour to broadcast a program where the major part of it will be in the nature of entertainment and the advertising only indirect.

"Radio has given us the greatest opportunity ever created by man to broadcast personality and atmosphere. We write a radio talk usually as the result of inspiration. That is the first requisite for a good talk—inspiration.

"After your inspiration, the second requisite to a good talk is that it must be a subject that you are thoroughly familiar with. You need a large background of experience that you can draw upon for facts, because there are only certain facts that you have at your disposal that can be shaped up in such a manner that you can make them of personal interest.

"Technical material, when used, must be brought into the talk in an indirect way, and be tied up to some human-interest experience that will hold the interest of the listener.

"You may have an excellent subject in which you have been properly inspired, you may be thoroughly posted, and you may develop it in the right sequence, but will the public be interested? How can you sustain their interest? In my talks I endeavor to break the talk at definite points and introduce something else of a poetic nature, something which has a humorous slant to it, or something concerning a real human-interest experience.

"With regard to transmission, I find that it is desirable to read the talk aloud ahead of time and listen to your voice, to see that you are speaking distinctly, slowly enough and that you are carefully enunciating each word.

"Radio talks should not be too long—between 10 and 12 minutes is ample. Where a talk is in two parts, and music is used before and after the talk, and as a background to part of the talk, it may extend to a maximum time of 18 minutes, including the intermission and interludes."

Types of Tubes

THE manufacture of radio tubes is now one of the largest specialized branches in the radio industry, as revealed by the fact that one firm has 15 different detectors and amplifiers on the market.

Radio tubes may be divided into four general classifications: detector, voltage amplifier, power amplifier and rectifier tubes. Within these classes some tubes are constructed to serve in storage-battery operated sets, others to be used in dry-cell operated receivers and still others for use in connection with socket-power devices, including "B" eliminators.

Type CX-300A is a new special-purpose tube designed for use only in the detector socket of receivers using five-volt tubes. This new detector will give a receiver clearer and sweeter tone and increase volume on far-away stations. Installation is merely a matter of taking out the old tube and inserting the new tube in its place.

Type CX-301A is a general-purpose tube for storage-battery sets and is one of the most popular tubes in use today. It may be used for amplification at either audio or radio frequency.

Type CX-112 may be used in place of the CX-301A in the last audio stage without change in the voltages. The CX-112 is a power tube and, feeding the loudspeaker, improves tone quality and gives increased volume. The CX-371 is a power-amplifier tube designed for the last audio stage.

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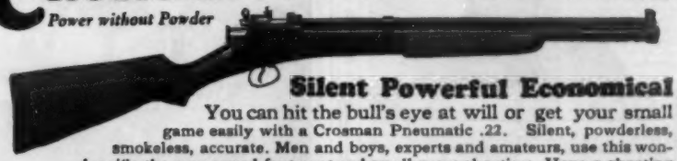

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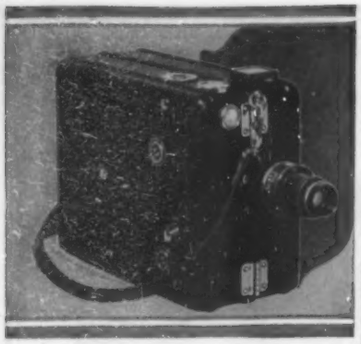

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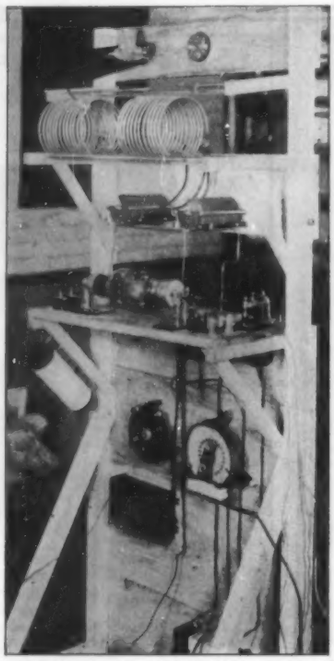


This short-wave installation is used by the Hydroelectric Power Commission in Ontario, for communication between their power plants

While this tube is more difficult to install than the CX-112 in receivers where provision has not been made for it, the task is not difficult for a technical man. The CX-371 practically eliminates all possibility of a signal distortion and improves the operation of any loudspeaker.

The C-299 and CX-299 types are general-purpose, high-vacuum tubes especially designed for extreme economy of operation from dry cells. The tubes are identical except for their bases. The C-299 has a special type, small bayonet-lock base while the CX-299 is mounted on the standard CX base. The former type is manufactured principally for replacement purposes, since new sets are designed for the standard push-type base. The CX-220 is a high-vacuum tube designed for dry-battery operation as a power amplifier to supplement either the C or CX-299. It is only used in the last audio stage to feed the loud-speaker with maximum undistorted power.

Types C-11 and CX-12, like C-299 and CX-299, are identical except for their bases. Both of these tubes are excellent detectors and audio-frequency amplifiers for dry-cell operated sets.

The CX-313 is a full-wave rectifier tube and the CX-316B is a single-wave rectifier of high power. These tubes are for use with socket-power devices, including "B" eliminators. CX-374 and C-376 are also tubes for special work in connection with receivers operating directly from the house lighting circuit.

CX-310 is a heavy-duty power-amplifier tube designed especially to operate heavy-duty loudspeakers. C-377 is a protective tube which, when connected in the "B" battery circuit, will protect radio-tube filaments against any possibility of accidental burn-out through wrong "B" battery connections or short circuits.

There are more tube manufacturers this year than last season. In most cases each manufacturer has a tube equivalent in operating characteristics to those mentioned in this article. The difference in the tubes, in several cases, is only in the letter prefix, as the numbers remain the same. For example, there is the CX-112 and a UX-112. Both are power tubes. Another designer designates his tubes with "DV" and "DL" prefixes, using these with the tubes designed to function in various sockets, just as in the CX or UX line.

Three Tubes in One

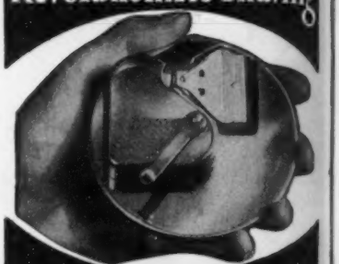
A NEW vacuum tube incorporating the equivalent of three ordinary tubes in one and known as the "multivalve" has been introduced by the Emerson Radval Corporation, exclusive licensee and manufacturer of the tube. It consists of the elements of three tubes embodied within a glass bulb. In outward appearance the tube is similar to the standard detectors and amplifiers, except that four binding posts are provided in the base of the tube for making connections with the extra elements within the bulb.

The tube is designed for use in any standard receiver with only slight changes in the wiring. One multivalve is sufficient to operate a loudspeaker while drawing only .25 of an ampere at five volts for the filament. In fact, a complete receiver may be built using only one multivalve. This unit can be operated by dry cells, storage battery or current-supply device with equally good results. If more power is required at the output, a UX-171 power tube can be incorporated in the circuit, giving sufficient volume and working as effectively as a four or five-tube set.

The characteristics of the tube are such that the plates will withstand a potential of 135 volts. The filament is of rugged construction similar to that used in standard tubes. Cut into three sections, one for each of the three grid and plate units, the filament units are connected in series so that the final current-consumption effect is the same as if a single 201-A type of filament were used.

Edouard Belin, famous French investigator in the transmission of photographs by radio, demonstrating some of his apparatus in Japan

Amazing Invention Revolutionizes Shaving



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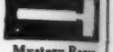

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When used in a super-heterodyne, two multivalves are necessary, one for the three intermediate amplifiers and the other for the detector and audio stages. The result when using this combination is estimated to be a saving of one ampere in filament current.

The tube fits the standard socket. Four prongs on the bottom, which make contact with the socket, supply the positive and negative filament connections and the plate and grid connections for the middle unit. The plate and grid connections for the other two units are taken from the binding posts attached to the tube's base.

Static Forecasts Storm's Approach

THE practical value of the radio compass in detecting and tracking hurricanes and typhoons at sea, as demonstrated in experiments conducted for two years and a half on board the *U. S. S. Kittery* by Lieutenant E. H. Kincaid were recently disclosed by naval radio experts.

The experiments were based on the theory that static is useful in identifying conditions of the weather in advance. Peculiar features of the *Kittery's* service assisted these experiments and afforded an unusual chance for the study of communications, static and weather conditions.

This small transport of 3,300 tons displacement is used by the Navy to carry naval and marine personnel and supplies from Hampton Roads to the various naval stations in the West Indies, and a trip is made every six weeks.

Previous to July, 1926, when the radio compass was installed on the *Kittery*, interference with reception of the radio messages from Arlington was recorded. Each time the radio men complained of heavy static, an area of changing atmospheric pressure was between the *Kittery* and Arlington, or the ship was close to some of the islands where local static was intense.

The type of weather map that coincided with the heaviest static was noted. In every case where static was intense, there was on the map a storm trough, or depression of low or falling barometer between the ship and Arlington. Since the areas of high pressure and low pressure north of the tropics drift consistently from west to east across the United States, similar conditions of the atmosphere to those that caused static were noted to the westward and before they drifted between Arlington and the *Kittery*.

The radio operator on the ship was instructed to report on static conditions he encountered. In every case his report of heavy static coincided with the arrival of the low and changing pressure between Arlington and the ship. Reception of

Lieut. Earl H. Kincaid, of the *U.S.S. Kittery*, with the direction finder used in the tests which he made to locate storms by observing the relative movements of static disturbances

Arlington's signals was impossible when the Nassau and Miami hurricanes were raising havoc between Arlington and the *Kittery*.

Cone Facing Wall Gives More Volume

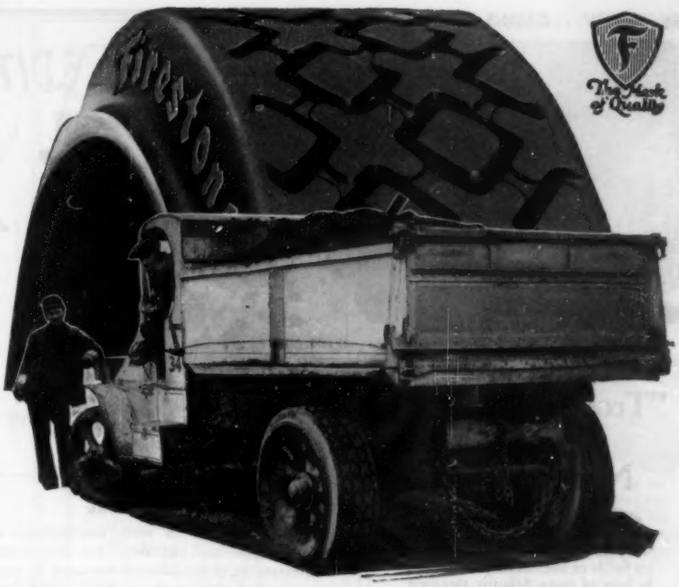
TESTS conducted in the Engineering Laboratories of the Crosley Radio Corporation show that a majority of the single-cone types of loudspeakers on the market produce greater sound volume to listeners directly in front of the speaker when they are placed with the point of the cone in the direction opposite to that of the listeners than when they are placed with the point of the cone toward the listeners.

Thus, fans who have placed their loudspeakers with the cone pointing away from the wall will usually find that they can slightly increase the sound volume by turning the speaker around so that the inside of the cone points towards the listeners. This hint will be found valuable in tuning to weak signals.

Engineers explain this slight difference by the fact that the cup-shaped inside of the cone is more effective in transmitting motion to the surrounding air than the slanting outside surface of the cone. Stronger waves are therefore set up by the inside of the cone than by the outside.

Wide World

Vacuum tubes are used in the train-stop system employed by the Reading Railroad and described in detail on pages 270 and 271 of this issue



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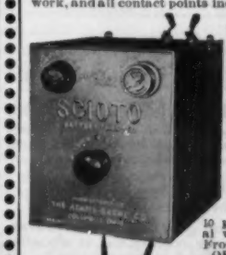

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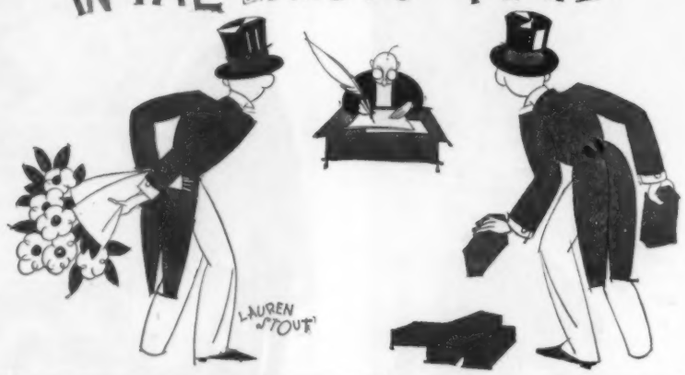
IN THE EDITOR'S MAIL



A Strange Break

Broken springs in such mechanisms as phonographs are not new, but the break illustrated in these columns occurred in such a way that the result is very interesting. Let the owner of the broken spring tell what happened.

Editor, Scientific American:

One of the coil springs on my phonograph recently failed and upon opening the case, we discovered the very remarkable condition shown in the enclosed photograph.

The spring was in 46 different pieces, 42 of which show in the photograph. Two or three coils on the outside were in large pieces which were a foot or more in diameter and I discarded them.

We do not know when the break occurred, but simply discovered the phonograph would not wind. This spring had been in use over ten years, although not very much of late, due to radio. It was rather dry although certainly not excessively so. The graphite shows plainly in the photograph and the broken pieces were very slippery to handle.

Although the whole fracture is very hard to explain, two features of it seem particularly interesting. The photograph shows rather clearly the remarkable way in which the two breaks ran through adjacent turns as though the spring were solid metal. The break in each turn takes the shape of those on either side, and nearly every irregularity in the break runs through a number of turns.

This fact and the appearance of the broken spring as a whole, would indicate that the fracture must have been instantaneous on both sides while the spring was tightly coiled; a straight, tensile break.

Strange to say, the break on each coil is bent slightly inward, with, in most cases, a projection on the inner surface, as though the spring had been broken by a sharp bend. This feature does not show clearly in the photograph, although it can be made out on some of the turns to the left.

Altogether I fail to form any theory as to what was the sequence of events when this break occurred and believe it may be a puzzle that would interest your readers.

Henry G. Hitt,
Ordnance Engineer,
Navy Yard, Puget Sound,
Washington.

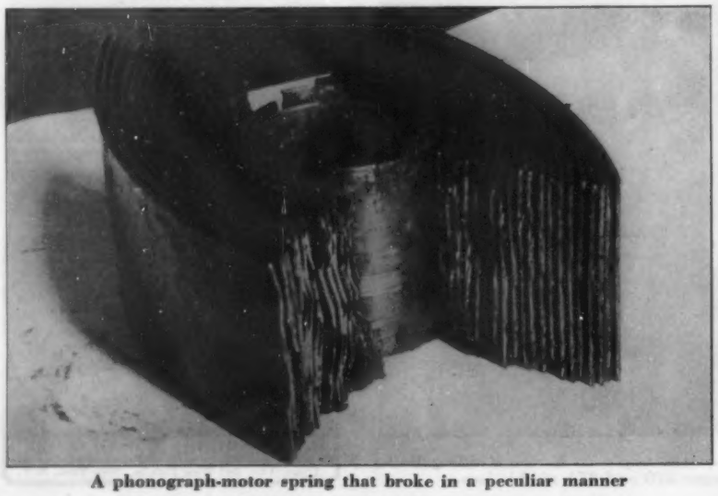
Going—Going—Gone: the Mosquito

How well Dr. David Starr Jordan's article on the mosquito fish, published in our issue of last May, has aroused public interest is proved by the letter published below. Dr. Jordan's mosquito fish is a tiny fishlet less than an inch long, that thinks the best dessert it has ever been indulged in is the larva of the mosquito. As the mosquito prefers human blood for its own dessert, we have our choice between feeding mosquitoes on ourselves or feeding mosquito fish on mosquitoes. These little fishes—they are not minnows, by the way—may be obtained, not from Dr. Jordan, but elsewhere. Readers might do well to call the attention of their local Boards of Health to Dr. Jordan's article and to the letter below:

Editor, Scientific American:

You may be interested to know that not only has the little mosquito fish been introduced in various places on account of our correspondence, but that, drawing on our experience in carrying it over to Hawaii, the Health Board of the Rockefeller Foundation, through Dr. L. W. Hackett, gave me the following information. I quote from Dr. Hackett's letter.

"*Gambusia* was introduced into Spain by Dr. Massimo Sella, director of the anti-malaria work, in 1922, with the help of the American Red Cross. Dr. Grassi, the famous Italian malariologist, had *Gambusia* brought to Italy from Spain. They were imported first to the drainage canals of Ostia and



A phonograph-motor spring that broke in a peculiar manner

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W. G. McKAY, Assistant Secretary

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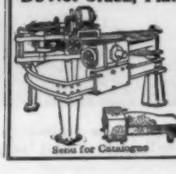

Send for Catalogue
American Pipe Bending Machine Co.
32 Pearl St. Boston, Mass.

Fiumicino at the mouth of the Tiber, and in the four succeeding summers have multiplied prodigiously. This fish seems to have left behind its natural enemies and to be more at home in Italian and Spanish waters than it ever was in America. For one thing, the weaker males, which in America are always found in disproportionately small numbers, here seem to survive, and in many cases equal the females in number.

"The International Health Board of the Rockefeller Foundation has recently established, in cooperation with the Italian Government, an experimental anti-malarial station in Rome, with field laboratories in different parts of Italy. This station has made a wide distribution of *Gambusia* in all parts of Italy, in Jugoslavia and in Dalmatia as well.

"These fish, owing to the enormous numbers which develop in ponds and streams, are more effective against mosquito larvae than they were in America. They will penetrate many kinds of horizontal aquatic vegetation, and will do away with from 80 to 90 percent of *Anopheles* larvae. There are many types of water, however, both permanent and intermittent, to which they cannot adapt themselves and our judgment is that although they are a great help in anti-mosquito work, conditions are rarely such as to make it unnecessary to do any other type of anti-mosquito work. However, as their introduction is inexpensive and their maintenance practically nil, they represent a measure of which practically any community in mild climates can avail itself."

(Signed) Lewis W. Hackett.

Very truly yours,
David Starr Jordan,
Stanford University P. O.
California.

Of Interest to Naturalists

MR. ERNEST KEIL of Dayton, Ohio, sends us brief descriptions of two rather interesting objects which he has found during his rambles afield. Says Mr. Keil:

"The object which the little lady, shown in an accompanying picture, is holding in her hands is the tooth of a mastodon which was found not so long ago near Dayton, Ohio. The molar weighs over one pound and the enamel protecting it is one-eighth of an inch thick.

"A bird's nest of unusual interest from an architectural standpoint is shown in another illustration. It is, or rather was, the home of a phoebe; a bird about the size of an English sparrow, belonging to the family of 'flycatchers.' All phoebe-birds are good nest builders, but this particular bird beat all known records of her tribe not only in the size of her home, but in its beauty and durability as well. For protection against her natural enemies, the bird could not possibly have made a better selection so far as material is concerned, and the neatness and elegance of the structure would put many an architect of the species *homo sapiens* to shame.

Mastodon tooth with characteristic separate hill-like cusps

The carefully built nest of a bird that desired a pretentious home

"The nest is of almost circular shape and has a diameter of well over ten inches. It tapers slightly towards the top, and its greatest height is six inches. The nest-cavity is three inches deep and two inches in diameter. However, the most marvelous thing about this nest is the way it was made. Some straw, a few strings and some other coarse material formed the foundation.

"Then, to conceal the cradle from the prying eyes of its enemies, the bird proceeded to weave an enormous basket of fine moss around it. Thousands and thousands of small pieces of moss had to be selected, carried and finally woven into the structure. The wonder of it is, that the slender, little bird managed to accomplish this enormous amount of work during the short time preceding the rearing of her family.

"But in spite of all the odds against her, she did a splendid job, for her home is a strong, homogeneous mass of tightly woven moss. I am willing to wager that the 'eight-hour day' meant nothing to this busy little mother-bird. If she claimed membership in a phoebe labor-union, she must have disregarded every law and by-law."

Ouch!

The letter reproduced below is one of the brickbats that occasionally reach the editor's desk. The error was not one of ignorance but was one of the things that happen in even the best run editorial offices.

Editor, Scientific American:

If the balance of Mr. J. Bernard Walker's article is as accurate as his statement that the Illinois River empties into the Missouri, it is a valuable article and I would like to know since when and how it got across the Mississippi and when that happened. I, when a boy, steamboated on the Mississippi River and I never saw the Illinois crossing over to the west bank to get into the Missouri.

E. S. Nowottiny,
Odell, Ill.

Motor-Horn Signals

Numerous signaling devices for use on motor-driven vehicles have appeared on the market. Some of them depend on the use of vision alone, while others combine a light or visual signal with a bell or other audible signal. One of our readers suggests a use for the horn of an automobile that might, if universally adopted, be of material value, either as supplementary to existing signals or as a complete system in itself. His letter follows. Possibly some of our other automobiling readers will want to comment on the signal code put forth.

Editor, Scientific American:

The "Universal Horn Signal Code" described below is not offered as a substitute for other signals in use but to supplement them in the interest of general convenience and safety. It is not intended for car drivers only, but "for all whom it may concern!"—(especially pedestrians and cyclists).

A forced landing meant death!

When Lieutenant Walter Hinton made his flight to discover the secret of the Parima River, he *had* to stay in the air. Below him stretched an impenetrable forest where a landing meant certain death.

To lessen the weight and thereby increase the cruising radius, he stripped the plane of all the tools but one — a NICHOLSON File. In his own words: "We cut our Nicholson File in half, for the weight saved represented a pint of gasoline. But half a Nicholson File was far more useful to us than any other tool would have been.

This striking proof of the usefulness of NICHOLSON Files is equalled only by their convincing record in doing everyday jobs in industry and the home.

Ask for them at your hardware dealer's.

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—a File for Every Purpose!

BIG MEDICINE—*the African witch doctor—not only used his drum to send messages for miles, and to stir the tribe to frenzy. He used it to tell, from the skin stretched over its end, when rain was coming.*

Although weather predictions of today are not infallible, they now have a scientific basis of fact that takes into account more than simply the moisture content of the air.

A question isn't answered . . . unless it's answered RIGHT

Fairy tales, Easter bunnies and Santa Claus may be harmless food for children, but in the big matters of life only the truth satisfies. This is particularly so of those scientific instruments which indicate human or industrial health. For the difference of a degree may mean life or death, in the human body; and in industry, success or failure.

The men who first developed the thermometer were satisfied with nothing short of the truth. The men in the Taylor Instrument Companies who carry that first development farther, to the greater protection of human life and property, are just as insistent on accuracy.

Today there is scarcely an industry, scarcely a human activity, which *Tycos* instruments are not protecting. They answer the questions of temperature recording, measurement and control, of weather forecast—and answer them *right*.

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Pyorrhea robs 4 out of 5

Many ills that shatter health begin in the mouth that is neglected. Pyorrhea, the frightful enemy that leaves in its wake such troubles as rheumatism, neuritis and facial disfigurement, wins only when ignored. Its hapless victims are 4 out of 5 after 40, and thousands younger.

Keep Out of Danger

It is folly to wait for warning signs, for gums to bleed or to recede, for teeth to loosen. As health protection, have your dentist give teeth and gums a thorough examination once every six months. And start using Forhan's for the Gums, now!

This dentifrice, if used regularly and in time, thwarts Pyorrhea or checks its sinister course. It is prepared for this purpose. It contains Forhan's Pyorrhea Liquid, used by dentists everywhere.

It firms gums, keeps teeth snowy white and protects them from acids which cause decay.

See your dentist and start using Forhan's, today. Teach your children this priceless health-habit. At all druggists, 35c and 60c.

Formula of R. J. Forhan, D. D. S.
Forhan Company, New York

Forhan's *for the gums*

More Than a Tooth Paste . . . . It Checks Pyorrhea

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Inasmuch as sounds arrest attention while vision must be directed or the signal is lost, why should not the alarm be *coded* so as to convey an intelligible meaning as well?

It is very difficult to properly signal the car ahead. Careful drivers invariably "horn" the car ahead when they intend to pass it and there are predicaments in which it is expedient to pass on the right instead of on the left. The "code" would be very useful in such cases.

Hand signals and mechanical signs are very useful but are difficult to interpret and those to whom they are directed frequently have their vision directed elsewhere and do not see them. These considerations, I think, if amplified a little will clarify the subject and justify the value of my suggestion.

If the Scientific American would take the lead and promulgate this code, it would "take" without legislative action, although, in the course of time, it would be widely legalized, no doubt.

When using the "Universal Horn Signal Code," the following series of horn sounds would be used to convey the corresponding intentions of the driver:

To stop: one blast (short, medium or long).

To start or continue straight ahead: two blasts (short, medium or long).

To turn right: three blasts (short, medium or long).

To turn left: four blasts (short, medium or long).

To pass car ahead on left: four blasts (two medium and two short).

To pass car ahead on right: three blasts (one medium, one short, and one medium).

To back up: five blasts (short, medium or long).

E. B. Rayner,
Piqua, Ohio.

The Heavens in April

By Professor Henry Norris Russell, Ph.D.

At 11 o'clock: Apr. 7.
At 10½ o'clock: Apr. 14.
At 10 o'clock: Apr. 22.

At 9 o'clock: **May 7.**
At 8½ o'clock: **May 15.**
At 8 o'clock: **May 23.**

At 9½ o'clock: April 30.

The hours given are in Eastern Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on April 7, etc.

NIGHT SKY: APRIL AND MAY

The Heavens

AT our customary hour of star gazing we find the Great Dipper high in the north; the Pointers, which are past the meridian, lead us downward and to the right to the Pole star, and beyond to Cassiopeia, low on the horizon.

Auriga is well down in the northwest, and Gemini and Canis Minor in the west. Hydra stretches far along the southern sky with Leo high above its head in the southwest, and Corvus and Crater on its back in the south. Virgo is above the latter and to the left. Then comes Boötes, with Arcturus, high up. Libra is in the southeast, and Scorpio is rising, as are Ophiuchus and Serpens in the east. Lyra is low in the northeast with Draco above on the left, and Hercules on the right. Corona lies between the latter and Boötes.

The Planets

Mercury is a morning star all through April and is visible before dawn, especially about the 10th when he is nearly 28 degrees from the sun—about his maximum appearing distance—and rises at 4:40 A.M.

Venus is an evening star and is very conspicuous, remaining in sight until 9:20 P.M. in the middle of the month. Mars is an evening star in Taurus and Gemini, and sets just after midnight on the 1st and at 11:40 P.M. on the 30th. Jupiter is a morning star, rising about two hours earlier than the moon. On the 6th, he is in conjunction with Mercury—the two planets being only half a degree apart. Mercury is south of Jupiter and only about one-tenth as bright.

Saturn is in Scorpio and comes to the meridian about 3 A.M. Uranus is just past conjunction with the sun and is unobservable, while Neptune, which was in opposition last year, can be seen telescopically in the evening.

The moon is new at 11 P.M. on the 1st, and is in her first quarter at 7 P.M. on the 8th; full at 11 P.M. on the 16th, and in her last quarter at 5 P.M. on the 24th. She is nearest the earth on the 1st and again on the 30th, and farthest away on the 15th. During the month, she passes near Uranus on the 1st, Venus on the 4th, Mars on the 6th, Neptune on the 11th, Saturn on the 20th, Jupiter on the 28th and Uranus later on the same day. Not one of the observable conjunctions is close.

The Origin *of* Reflecting Telescopes

We have to thank Sir Isaac Newton of gravitation fame for our first reflecting telescope. There has been much discussion as to whom credit is due for our refracting telescopes, but the records are quite clear as to the origin of the reflector. Sir Isaac constructed his first instrument in 1666.

It is indeed peculiar that an instrument dating back to 1666 is so little known except among those intimately interested in Astronomy. We venture to state that if you asked the first ten men you met on the street what a reflecting telescope was you would get an evasive answer. If it were explained to these same ten men just what a reflecting telescope is and how cheaply any amateur could build one, we wonder how many of the ten would not soon be testing their skill.

To the average man the heavenly bodies are mere vagaries; he knows they exist, having been taught as much. If a man tells you he has a good horse that he will sell, right away you say "let me see the horse." But if your instructor tells you a long story about Mars, Saturn, or any of the other heavenly bodies, you ask no questions. There isn't the slightest doubt that he is right, but why not apply the rule of the horse?

We admit there is a possible reason for this attitude, for up to now there has been nothing that would tell the amateur how he could build a telescope, and even if he had the ingenuity to do this on his own initiative, he was unable to get the proper material, not knowing the sources.

These questions have been recurring from time to time with the Editors of the Scientific American. They finally came to the conclusion that the subject was something that should go on record. The fancy became a fact with the appearance of Amateur Telescope Making. We can now offer

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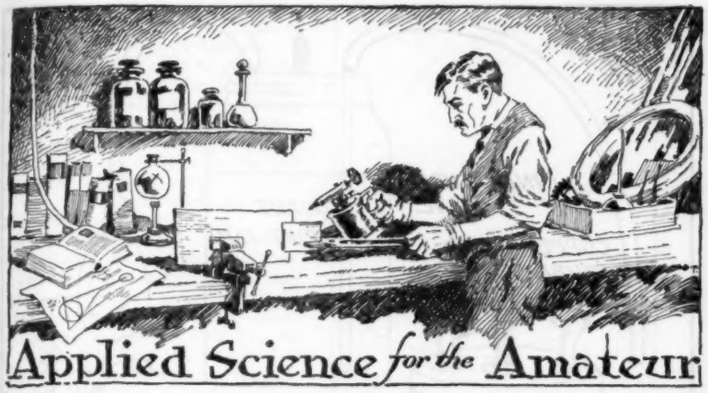

Applied Science for the Amateur

A department devoted to the presentation of useful ideas wherein will be found material of practical value for those who are mechanically inclined

Conducted by A. P. Peck

Further Note on Dry Rectifiers

THE article entitled "A Distinctly New Rectifier" which appeared in the September, 1926 issue of the Scientific American has resulted in many inquiries from readers, some of whom have been carrying on experiments as suggested. While results have been obtained in every case, these have been so erratic as to have little practical value and upon inquiry from original workers in this field it was found that their results too are not all subject to easy repetition.

Because of this we wish to call attention to a recent paper presented before the American Physical Society at Philadelphia by J. A. Lilienfeld and C. H. Thomas. In this paper it was pointed out that the pressure was of more importance with respect to rectification than had previously been supposed and that with a given available compressing force a definite contact area has to be maintained. Thus, instead of coupling the rectifier parts with a three-eighth-inch bolt and screwing down the nuts as tightly as possible as described in the mentioned article, there is placed beneath each of the nuts a large helical spring consisting of two or three turns of steel about the size of a lead pencil and capable of exerting a force of about 1,000 pounds. For a force of this magnitude, the area of the contact layer is only about 25 square millimeters for the materials which the experimenters used; the rectifier consisting of aluminum and nickel plates with cupric-sulphide powder between, the nickel electrode being cup-shaped to retain the powder.

The cell, according to the description given at the American Physical Society, will deliver 2.5 to three amperes direct current at two volts. The resistance of the cell decreases with the pressure, up to a certain limit. It was claimed that through a new filter circuit of inductances and resistances it was possible to suppress the alternating-current ripple to less than 1 percent of the total voltage. It was further claimed that this particular cell was not subject to variations of behavior such as have so greatly troubled other workers in this field.

The particular items of interest to those who have already begun work in this field as a result of the previous article are first, the addition of the spring for the purpose of maintaining constant pressure and second, the fact that the relation of area of contact with respect to pressure is critical. While this relation is given in this note, it should not be assumed that it will hold for all materials such as have been suggested previously and it will therefore be necessary to make repeated measurements, varying the relation between pressure and area in each case until the most satisfactory result is secured.

The author hopes that this additional note will give further encouragement to those who are experimenting in this field and will be glad to hear at any time of any progress that they may make.—*Contributed by H. H. Sheldon, Ph.D., Chairman of the Department of Physics, Washington Square College, New York University.*

Soldering-Iron Stand

WHILE the small alcohol torches of the type shown in the accompanying illustration are very handy for small work, yet when it comes to the heating of a soldering iron, trouble is experienced in holding the iron over the flame in a position that will take the greatest advantage of the heat. To overcome this difficulty, a very simple stand can be fashioned from several lengths of twisted wire. The rack shown was made from bus-wire such as is often used for wiring radio sets. Of course, any other wire that is heavy enough may be used. It is desirable to twist all of the joints tightly, rather than to solder them. In the latter case, there is danger of wrecking the stand if the torch comes close to it and melts the solder.

The problem of holding a small soldering iron in place over an alcohol flame or other type of heater is easily solved by constructing a holder similar to that shown in the above photograph. Heavy wire may be used

Storage Battery Filler for Concealed Batteries

FOR some unknown reason many makers of automobiles hide the storage battery away in places that are almost impossible to reach. For this reason it is awkward and difficult to properly fill the cells with water. The filler shown in the illustration on page 290 has been designed to lessen these existing difficulties and can be made by anyone handy with tools.

The distilled water is put in a common screw-top fruit jar. The screw top should be pierced with three holes about one-quarter of an inch in diameter. These can be

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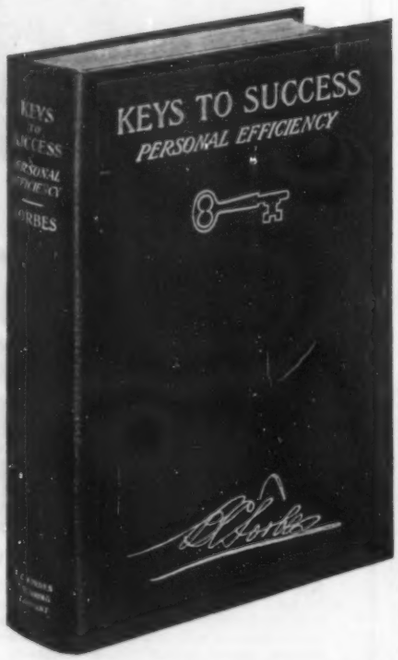
KEYS TO SUCCESS

How to Develop Your Personal Ability

By B. C. Forbes



B. C. Forbes, editor of FORBES MAGAZINE, has interviewed hundreds of business and financial leaders; he has studied their careers; he has dug deep into their methods. He has found out why they reached their present position of wealth and power; he has discovered how they made their financial mark. Mr. Forbes has eliminated those phases that are peculiar only to the individual genius of business. He has selected only those principles, methods and practices which you can apply at once to your lasting profit. You will find them all in B. C. Forbes' invigorating and inspiring book—KEYS TO SUCCESS: How to Develop Your Personal Ability.

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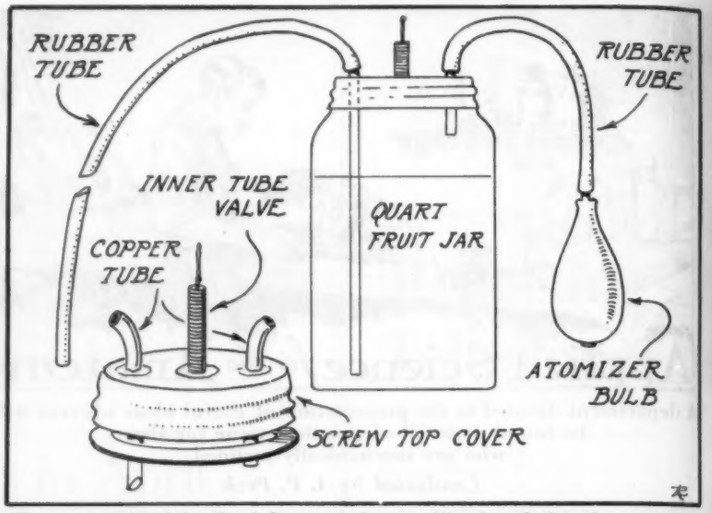


The constructional details of the simple battery filler described in these columns are given above. Be sure that the entire unit is airtight

reamed out later to accommodate the different parts applied.

First run a length of soft copper tubing, one-quarter of an inch in bore, down through one hole nearly to the bottom of the jar and solder it in place around the hole. Then solder a second but shorter piece in another hole in the same manner as indicated. A tire valve should be soldered in the third hole and fitted with an inner valve to the stem of which has been soldered a piece of wire about one inch long.

Bend the upper ends of the two copper tubes outward in a curve and push a fairly long piece of rubber tubing over the one that projects down into the water. A shorter piece of rubber tubing should then be pushed over the short copper tube and supplied with a fairly large rubber bulb. This latter should have an air intake valve in its large end such as will be found in the bulbs used on some types of atomizers.

The utility of this filler will be instantly appreciated by the user who finds it awkward to reach the cells of his battery for filling. Place the end of the long rubber tube in the filler hole of the cell and press the bulb two or three times. This creates air pressure in the jar and forces the water up into the long copper tube and into the cell. The instant the cell is filled, a slight pressure on the inner-valve wire releases the pressure and the water ceases flowing. Then the next cell can be filled in a like manner.

Care should be exercised to make all soldered joints tight and use a rubber jar ring under the top when it is screwed down so that the compressed air will not escape. —*Contributed by L. B. Robbins.*

Neutralizing Radio-Frequency Circuits

EXPERIMENTERS building tuned radio-frequency sets often find that they are not self-neutralized and that they squeal on the shorter wavelengths. A variable resistance with a maximum resistance of about 700 ohms connected in series with the grid of the second tube, between the condenser-to-coil connection and the grid post on the socket will often clear up the trouble. If not, try the same size resistance in the grid circuit of the first tube as well. The values of the resistances should be adjusted carefully until the best results are obtained. This point will be found where the amplification at the lowest wavelength to which the receiver will tune is at its maximum and still no squeal is present.

Putting the Right Edge on Plane Irons

UNLESS a plane iron is carefully ground, marks are likely to be left on wood that is intended to be nicely finished. To avoid leaving such marks, the iron should be ground to fit the tool in which it is to be used. In single-iron jack-planes, the edge of the iron should be somewhat rounded, in an ordinary jack-plane only slightly rounded and for smoothing, panel and trying planes it should be ground straight except for slightly turned-up corners. For all other planes leave the entire edge straight. In other words; for planes used on work to be finely finished, grind the edge straight and accurate but round the corners slightly to prevent them from making marks on the surface of the finished wood.—*Contributed by L. B. Robbins.*

Keeping Auto Headlights Bright

IN these days of automobile-headlight laws, it behooves the owner of a car to keep his lights burning as bright and uniform as possible. This can only be done by using a little care and giving the reflectors and lenses their share of attention.

First inspect the bulbs. Long burning will gradually deposit a dark coating (thrown off by the heated filament) on the inside of the bulb. With one such darkened bulb and the other bright, the illumination will be uneven. The only remedy is to get a new bulb.

Now look at the reflectors. If dusty or greasy, rub them lightly with a clean silk handkerchief or soft cloth, using a circular motion. If they are badly scratched or tarnished have them replated or get new ones.

To prevent tarnishing, keep the interior of the headlights dry. This can be done in a great measure by occasionally renewing the cotton cord gasket under the lens rim. Never use rubber as the sulphur contained therein will eventually ruin the best reflector made. See that the gasket fits tight all around so it will keep out rain and mud.

The lenses can be kept clean and shining by rubbing with alcohol on a clean rag.—*Contributed by L. B. Robbins.*

Soldering Lugs

WHEN wiring radio or electrical instruments permanently, a better looking job can be produced if soldering lugs are used at the binding posts. This is preferable to the usual practice of bending the wire around under the cap of the post. The wire is soldered to the lug and the latter is then clamped tightly in the post.

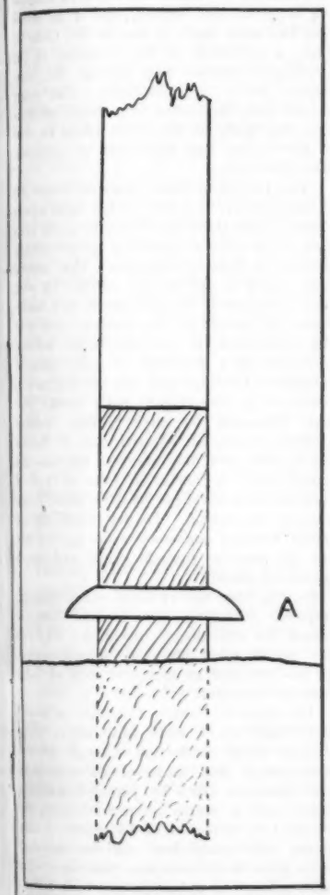
An Adjustable Insect Barrier

ACCORDING to Thomas E. Snyder, of the Bureau of Entomology, United States Department of Agriculture, the most injurious termites in this country are subterranean in habit and require constant access to the earth in order to attack wood which is either in contact with the earth or which they reach through covered, earth-like shelter tubes constructed over the face of stone, concrete, brick foundations or tim-

bers impregnated with wood preservatives. In consequence they can be kept out of buildings by means of metal barriers.

By simply inserting a sheet of galvanized iron, zinc or copper, or "termite shield," into the masonry and turning the projecting edges downward at an angle, communication of termites with the earth, where they obtain moisture, can be cut off. In less pretentious frame buildings, metal caps are placed over the tops of stone piling or pillars, or wooden supports.

To prevent subterranean termites from running earthlike shelter tubes over the treated butts of telephone, telegraph or electric light poles, as they have done in the case illustrated, an adjustable metal insect barrier has been devised. This can be placed on the pole from one to two feet above the ground line and should lengthen



"A" indicates a simple form of shield that will prevent termites from building their runways, and thus existing on poles and weakening them

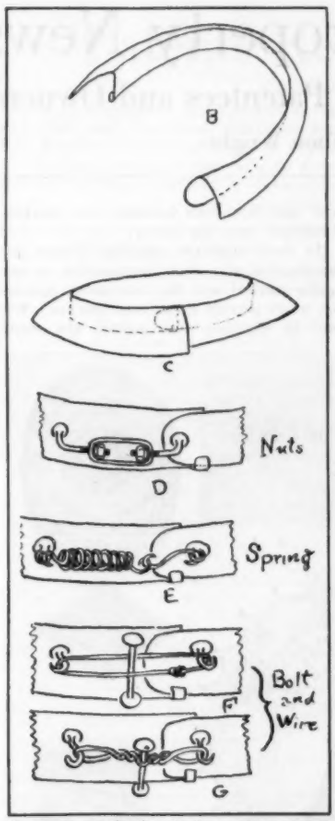
the lift of butt-treated poles in regions where termite damage is serious.

This barrier can be made of metal and fastened in place by any of the methods shown.

Draining a Storage Battery

THE average man should never attempt to drain the electrolyte from his storage battery through the vent provided for filling. During the life of a battery quite a portion of the active material constituting the plates will be shed and will drop to the bottom of the cells in the space provided for it. In time, quite a bit of it collects and if the battery is turned upside down to drain the solution and wash out the cells, this sediment will naturally fall with the liquid, lodge between the plates and form short circuits which will eventually ruin the battery. It will be found practically impossible to remove it all from between the plates, even by flushing with water.

To properly drain the cells, the sealed top should be removed and the plates taken out.



Several methods of fastening metal shields of the type illustrated in the drawing at the left. Any one of these systems will be found to hold the shield quite firmly

Then the jars can be emptied. The job should be left to a competant battery man who will have the tools to do it right.—*Contributed by L. B. Robbins.*

Precautions in Electrical Work

WHEN several circuits from the main house wiring are used in the experimental laboratory, it is wise to protect each one of them with fuses. At the point where the lines are taken from the house circuit, via an outlet, a block should be installed and equipped with 10-ampere fuses. Then each separate line should have its own block, in which six-ampere fuses should be used. By employing this system, the house wiring will be amply protected. An accidental short circuit on one of the branch lines will only result in the blowing of its own six-ampere fuses and will not put the rest of the lines out of commission.

Earth-covered runways of wood-destroying insects, 15 feet above the ground and communicating with it

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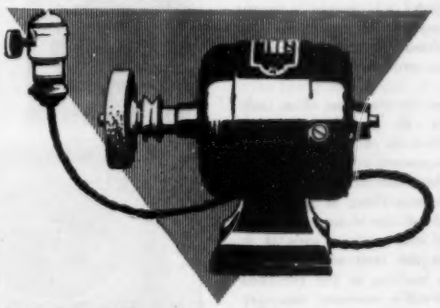

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Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

New Law Requires Patent Notice on Articles

AN important amendment of interest to all patentees has been made to Section 4900 of the Revised Statutes. It reads as follows:

"It shall be the duty of all patentees and their assigns and legal representatives, and of all persons making or vending any patented article for or under them, to give sufficient notice to the public that the same is patented; either by fixing thereon the word 'patent,' together with the number of the patent, or when, from the character of the article, this cannot be done, by fixing to it, or to the package wherein one or more of them is inclosed, a label containing the like notice: *Provided, however,* That with respect to any patent issued prior to April 1, 1927, it shall be sufficient to give such notice in the form following, viz.: 'Patented,' together with the day and year the patent was granted; and in any suit for infringement by the party failing so to mark, no damages shall be recovered by the plaintiff, except on proof that the defendant was duly notified of the infringement and continued, after such notice, to make, use, or vend the article so patented."

What Is a Clerical Error?

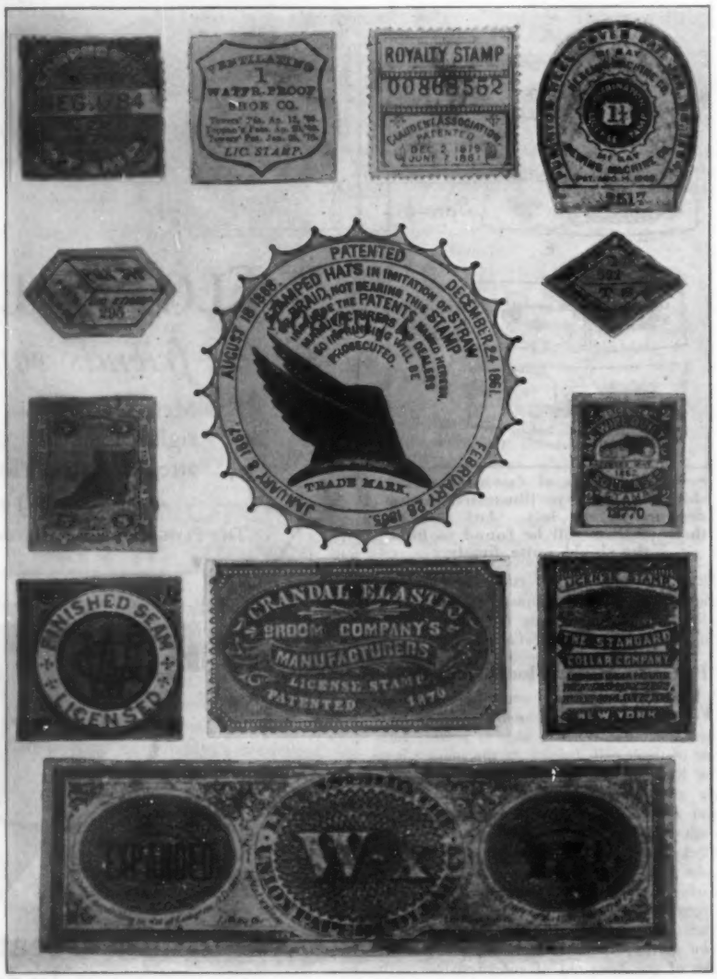
THE United States Customs Court, in overruling a protest of Richenback and Company, importers, defines the term "clerical error." Invoices were prepared at the direction of the importer's customs manager but he did not read the invoices and, therefore, did not deduct certain non-dutiable items. Later, a refund was sought through protest to the customs court upon the ground of clerical error. In explaining why a refund cannot be ordered, Judge Young writes:

"An oversight in the exercise of a task requiring discretion or judgment cannot properly be regarded as a clerical error. Clerical error presupposes a purpose to do something other than was done, the intention to do some definite thing of a clerical nature and instead of the doing of something else. In the case at bar, even if it were admitted that the task was a ministerial one, there is nothing in the evidence to show that plaintiff's customs manager intended to do anything other than what he did do. The error seems clearly to have occurred on account of a lack of judgment or else the failure to exercise any judgment at all in a situation requiring its exercise. The task was one requiring discretion, and discretion was not employed, or if employed, an erroneous conclusion was reached."

The Geographical Limits of a Trademark

A TRADEMARK used on goods sold only in one part of a state is not infringed by a similar trademark used only in another part of the same state. So rules Judge Gare of the Federal District Court for Middle Tennessee, in dismissing an infringement suit brought by the Scott County Milling Company against Philipps-Trawick Company and others. The former sold flour marked "Buttercrust" in western Tennessee; the latter sold flour marked "Butter Krust" in middle Tennessee.

"The adoption of a trademark does not, at least in the absence of some valid legislation enacted for the purpose, project the right of protection in advance of the extension of the trade, or operate as a claim of territorial rights over areas into which it thereafter may be deemed desirable to extend the trade," says the court. "And the expression, sometimes met with, that a trademark right is not limited in its enjoyment by territorial bounds, is true only in the sense that wherever the trade goes, attended by the use of the mark, the right of the trader to be protected against the sale by others of their wares in the place of his wares will be sustained."



Echoes of royalties. In February we published pictures of a few royalty license stamps. Inventors and philatelists sent us in some more and a few of them we are showing now to recall the way the patentee's profits were fixed in the old days when pasting stamps on patented articles made elaborate bookkeeping unnecessary. The inventor just watched for the stamp on the goods

Three Pairs of Shoes

DID you buy three pairs of leather shoes last year? Three pairs were made for you by the manufacturers of the country. The total production was 324,513,695 pairs, as compared with 323,553,055 in 1925, and 313,230,157 in 1924.

Perhaps you did not have your three pairs, but the women of the family made up the difference. Women's high- and low-cut leather shoes jumped tremendously in quantity, due to the decrease in shoes with canvas, satin and other fabric uppers.

The Foreign Label

GOODS from abroad, to avoid a 10 per cent penalty for non-compliance with the 1922 Tariff Act, must be plainly marked with the country of origin, thus: "Made in England." So rules the United States Customs Court in over-ruling a protest of Sidney Blumenthal and Company, Inc. Their goods from England were marked "Huddersfield" and those from Germany were marked "Crefeld." Says the court:

"In these cases the importers protest the classification of certain merchandise as not legally marked and the consequent imposition of 10 percent extra duty thereon. We find, in the first case named, the word 'Huddersfield' was stamped on the merchandise and in the other two cases the word 'Crefeld,' it being insisted by the importer that Huddersfield was sufficient indication of England as the country of production and that Crefeld was sufficient indication of Germany as the country of production. The court cannot so hold and the protests are all overruled."

The Coolidge Patent Case

THE decision of Judge Hugh Morris in the Federal District Court in Delaware, declaring invalid the 1913 Coolidge patent for ductile tungsten, owned by the General Electric Company, is hailed by other companies as the blow which breaks up a monopoly said to exist since 1913.

The suit for infringement was brought by the General Electric Company against the DeForest Radio Company and the Robelin Piano Company. The specific acts upon which action was based were the manufacture and sale by the DeForest Company of radio tubes having ductile tungsten tubes made to its order by the Mallory Company, an alleged infringing manufacturer of drawn tungsten wire, and the resale of those tubes by the Robelin Piano Company, a DeForest distributor.

The board defenses were invalidity and non-infringement, the defendants declaring first that no invention was made in ductilizing tungsten, and second, that if an invention had been made, it was by Dr. Colin G. Fink, a co-worker of Dr. Coolidge, in Dr. Coolidge's absence and without Dr. Coolidge's advice or assistance. The court agreed with the former contention; no decision was made on the latter phase in view of the finding that there was no invention. Said the court:

"The failure to draw tungsten before the present century is a fact of but little significance, I now think, in determining the presence or absence of invention in the claimed process of drawing tungsten. That process must stand or fall on its merits. Of what does it consist? Nothing more, as I understand the record in the present case, than the application of the old metal working processes to a coherent or solid mass of tungsten. Coolidge was not the first to conceive of or even create such mass. Jaeger and Hanaman by their patent Number 1018502, having an effective date of November 4, 1904, not only claimed, but also disclosed how to make, a wire or rod of tungsten in a coherent metallic state, homogeneous throughout. To that metal the old metal working processes were applied and the old results—wrought metal and drawn metal—obtained."

Dr. Coolidge has received many honorary degrees, including the famous Rumford medal, for this alleged invention. The Edison medal voted him for his achievement, he has declined to accept in view of Judge Morris's decision.

The General Electric Company is said to have built up a huge business in incandescent lamp production through its own manufacture and those of its subsidiaries and licensees, aided by patent litigation in which not a single adverse decision was received in a period of 15 years. A sales policy was established whereby the retail sales price to the consumer was fixed. This sales policy was upheld by the United States Supreme Court, a decision being rendered to the effect that the company could refuse to sell its lamps to anyone who resold them at prices lower than those fixed.

With other manufacturers now free to make incandescent lamps in competition with the General Electric—which would seem to be the effect of the patent decision—much of the effect of the resale policy may be nullified. The ultimate benefit, it is hoped, will be lower prices.

Aviation Sausages

WHEN Arnold Busch and Sons, of Chicago, sought recently to register as a trademark for sausages the representation of an airship with the word "Zeppelin" printed on it, John Morrell and Company, of Ottumwa, Iowa, opposed the registration, because their trademark for breakfast bacon consisted of a similar airship with the word "Airship" thereon.

The Commissioner of Patents refused the application for registration, holding that, while the two words are wholly dissimilar, yet when they are used upon the same type of airship they have the same significance. Bacon and sausage, he held, belong to the same class of goods and sausage manufacture would lie within the expected expansion of a bacon business.

The Broadcaster Infringes

A HOTEL orchestra, without authority, plays a copyrighted musical composition. A radio company sets up a microphone and broadcasts the music, for the purpose of stimulating radio products. Does the radio company infringe the music publisher's copyright?

Yes, says the Federal Court for the Southern New York District, though the broadcaster did not participate in rendering the music, except by affording listeners the opportunity to hear it.

"It is not enough to say that the broadcaster merely opens the window, and the orchestra does the rest," declares Judge Thacher. "On the contrary, the acts of the broadcaster are found in the reactions of his instruments, constantly animated and controlled by himself, and these acts are quite as continuous and infinitely more complex than the playing of the selection by the members of the orchestra.

"That in the process of transmission there is no audible rendition of the musical production until it is heard by the owners of radio receiving sets merely emphasizes the fact that the broadcaster is actively engaged in transmitting to the radio audience the original unauthorized production.

"In so doing it seems clear that he participates in the infringement. Certainly if he broadcasts, without authority from the owner of the copyright, a private rehearsal of a copyrighted production, thus converting the private rendition into a public performance for profit, he contributes to the resultant infringement. If, in the case at bar, the public has been excluded from the public ballroom at the hotel while the orchestra continued to play and the broadcaster to broadcast, he would have contributed to the infringement while the public was absent, but the presence or absence of an audience in the hotel cannot change the character of his acts of contributory infringement."

Victory for the Disk Wheel

ROSCOE C. HOFFMAN has won his suit for infringement against the Motor Wheel Corporation, Judge Tuttle declaring that his improvement in automobile disk wheels constitutes a step forward in the wheel art and represents genius and invention.

"While the automobile art, comparatively speaking, is a new art," says the court, "yet the basic patents are beginning to have run their 17 years, and while the disk wheel as used in the automobile art is new as compared with the military or wood-wheel type, it nevertheless has been in existence for a number of years, and many inventors and mechanical engineers had been designing disk wheels for some time prior to the patent in suit, without disclosing this particular feature.

"Having the reinforcing disks on opposite sides was old, but to have the disks free at the periphery and under tension on opposite sides was the thing that helped. Getting the right thing on one side or the wrong thing on both sides was not enough to spell success.

"In the use of an automobile wheel we are continually having strains laterally in opposite directions and in quick succession. When we are having a lateral strain in one direction on the right wheels, we are likely to be getting a strain in the opposite direction on the left wheels. It was just as important to have the right thing on both sides as it was to have it on one side; in fact, it was one of the links in the chain, and you cannot have a good chain until you have all the links good. All of those things ought to be put into the pan when we weigh this patent and see whether or not it is heavy enough in genius to call it a patent.

"This great automobile wheel art not only involves the joy of riding in these cars and carrying loads in them, but is coupled with one of the greatest dangers to life in this country. If the wheels do not stand up we are in danger. So we are dealing with something which involves both the joy of living and the sorrow of death when dealing with an automobile wheel. Any person who will add to that joy and detract from that sorrow ought to get some reward somewhere, and I believe that this step has been helpful enough to the art so that this invention was entitled to a patent."

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Apparel

BELT BUCKLE.—Equipped with means for engaging a button upon the trousers of a wearer, so that the buckle will always retain its proper central position. Patent 1610237. J. V. Belli, 45 Mahar Ave., Clifton, N. J.

COLLAR.—A turn over collar of the semi-soft type having wings at the front, yet providing an enclosed portion for the tie giving a neat appearance. Patent 1613653. H. C. Goetting, 456 W. 145th St., New York, N. Y.

BELT BUCKLE.—Especially adapted for personal wear, and the support of garments, the interengaging members being securely held, yet readily disengaged. Patent 16533. (Reissue). R. Slote, 49 E. 21st St., New York, N. Y.

POCKET FOR GARMENTS.—Which may be applied to any kind of wearing apparel, and from which coins cannot be readily moved even when the pocket is inverted. Patent 1613664. L. P. Lewandowski, Loup City, Neb.

VANITY HAT LINING.—Wherein substantially the usual appearance is presented while a special ornamental section is provided for carrying small articles. Patent 1613675. J. M. Peedie, 17 Oakland Ave., Grantwood, N. J.

Chemical Processes

INSECTICIDE AND PROCESS FOR PREPARING THE SAME.—Comprising extract of quillai bark, seeds of Lupinus, and the sodium salt of an inorganic acid, applied in powder form, odorless, and uninjurious to human beings or domestic animals. Patent 1610167. W. Schmitz, c/o of Tinolan Co. of Am., Lewis and Ashland Sts., Philadelphia, Pa.

METHOD OF UTILIZING WASTE SULPHITE CELLULOSE LYE.—Consisting of mixing the lye with an absorbent material and heating the mixture in a closed vessel to a temperature about 180 degrees, Centigrade, thereby producing a fuel. Patent 1615102. C. G. Schwalbe, c/o F. Schwenterley, Konlggratzerst 59, Berlin S.W. 11, Germany.

PROCESS FOR THE PREPARATION OF PEARL ESSENCE.—Consisting in mixing sulforicinates with the essence in order to bring the moistened crystalloids to the surface and separate them from the impure liquid. Patent 1615770. J. Paisseau, c/o C. Bletry, 2 Boulevard de Strasbourg, Paris, France.

Electrical Devices

AUTOMATIC CONNECTER.—So constructed that it will automatically open or close the plurality of circuits to various lamps of a lighting fixture, by manipulating a cable. Patent 1613825. G. A. Harmon, 1760 E. Main St., Columbus, Ohio.

TERMINAL CLAMP.—For electric connections, adapted for use with storage batteries on automobiles, sufficiently rigid to give satisfaction without the application of solder. Patent 1613104. C. F. Hellman, 1433 W. 47th St., Los Angeles, Calif.

ELECTRICAL TIME SWITCH.—Which may be used in conjunction with the ordinary switch, the circuit remaining closed up to a predetermined period. Patent 1615163. C. W. Brown, Mount Vernon, Wash.

Of Interest to Farmers

COTTON PICKER.—Adapted to be drawn over a field and equipped with picker elements positioned at opposite sides of the plants, and mechanism for discharging the lint. Patent 1610067. E. F. O'Haver, Box 312, Carlisle, Ind.

COTTON PICKER.—For the removal of cotton by the passing of rapidly rotating fingers through the plant, and the subsequent pneumatic delivery to a cylinder. Patent 1610240. H. N. Berry, c/o Dr. H. A. Gamble, Greenley Bldg., Greenville, Miss.

SILO SEAL.—Comprising a cap member vertically guided for gravitational sliding within the silo, for preventing the entrance of air, and the spoiling of ensilage. Patent 1611025. F. Gunther, 904 Putnam St., Peru, Ill.

HAY WAGON.—Having a hay-supporting platform by means of which the entire load may be deposited at the rear without the necessity of an extra man. Patent 1610582. G. Pegariek, Oxford Junction, Iowa.

ADJUSTABLE SUPPORT FOR BRANCHES.—Consisting of a metal ring to be slipped over a prop, and connected by the binding action of the load in supporting fruit tree branches. Patent 1613716. C. Mylaeus, c/o Loubier & Harmsen, S.W. 61 Belle-Allianceplatz 17, Berlin, Germany.

GATE.—Operated by a bumper of a vehicle, or by a pedestrian, to open the same, but gravitationally self-closing, constructed to prevent the passage of cattle. Patent 1615095. J. W. Matthews, Menard, Texas.

ADJUSTABLE BRACKET.—For supporting hog troughs, and having simple means for preventing the overturning of the trough, thereby keeping the pen clean. Patent 1614550. C. J. Hass, Chester, South Dakota.

PLOW.—Which may be organized with a tractor in such manner as to take advantage of the powerful pushing or propelling action, and to plow to a desired depth, the depth of cut being easily and accurately controlled. The inventor has been granted two patents 1614673 and 1614674. L. C. Hester, 1736 Walnut St., Jacksonville, Fla.

PLOW.—Which comprises means for supporting a shovel blade or "sweep" for use in effecting shallow cultivation of cotton or like plants. Patent 1615561. H. T. Young, Darlington, S. C.

Of General Interest

PERPETUAL CALENDAR.—May be used from month to month and year to year by a simple adjustment and adapted for use upon a fountain pen, pencil, upon a pillar such as in a bank, upon a paper weight, etc. U. S. patents 1500013 and 1551530 and Canadian patent 241649. Donald R. Adams, Box 470, Fairbanks, Alaska.

HOSE SUPPORT.—Which is runner proof, small, neat and holds the hose securely, a soft covering to the button head and pivotal movement of the clasp, positively preventing runners in the hose. Patent 1598126. Janet G. Fleming, corner Victoria and Arlington Aves., Riverside, Calif.

COLLAPSIBLE WINDOW GUARD.—To be attached to the inside casing of window. Made of perforated galvanized iron panels hingedly connected to insure safety against burglars entering room after window is raised. Patent 1618060. Mrs. Addie W. Cooke, 211 Newman Building, Memphis, Tennessee.

UMBRELLA COVER AND GARMENT.—Adapted to be worn over a bathing suit while walking through the streets, or to serve as an umbrella at other times. Patent 1613688. D. Weisz, 206 E. 9th St., New York, N. Y.

EXTENSIBLE SIDE BRACE FOR STEPLADDERS.—Easily applied and removably attached to the sides of a stepladder for preventing the ladder from toppling sidewise. Patent 1610596. F. J. Bird, 92 7th St., San Francisco, Calif.

RING DIAL.—For accurately indicating time in the presence of direct sunlight without providing any increase in dimensions above an ordinary ring dial. Patent 1610533. E. Pozzi, Lagunitas, Calif.

COLLAPSIBLE CLOTHES TREE.—Which, though rigid and serviceable for suspending articles of clothing, is capable of being folded into compact space for storage or shipment. Patent 1610534. F. A. Rice, 1762 Pine St., San Francisco, Calif.

VANITY CASE.—Constituting a dispensing container for loose powder in which the puff is connected with means for dispensing the contents through its applying face. Patent 1612593. H. MacDougall, 85 Oakland Road, Maplewood, N. J.

A Can-opener Infringement

EVER since food has been packed in tin cans we have had can openers of one kind or another and the number of them for which patents have been applied is legion. In an art so crowded, the man who not only can get a patent but can successfully suppress an infringer is to be congratulated.

Such is the case with the Star Can Opener Company's device, a manually operated tool which grasps the flange of the can and cuts off the top just below the flange. In holding the patent valid and infringed by the Owen Dyneto Company, Judge Hough in the Circuit Court of Appeals for the Second Circuit says:

"Plaintiff's commercial embodiment of these patents has, without the meretricious aid of advertising, achieved in an extremely short time marked commercial success. It is a true tool—that is, manually operable without the expenditure of much physical strength—strong, light, cheap and apparently durable. That upon the ordinary food tin, composed of light sheet-metal, it makes a cleaner job, with far less risk of personal injury to the operator, than does any other can-opening tool brought to our attention, is, we think, admitted.

"Defendant's article is, in our judgment, a copy of plaintiff's commercial product, except that, instead of arranging the levers scissor-wise, they operate like a nut cracker; that is, there is a change from one class of lever to another.

It is not contended that infringement can be escaped by such a device; but it is urged that, since the claims of the first patent all speak of cutting disk and advancing roller 'mounted at the end' of a handle or lever, that defendant's nut cracker arrangement prevents the rollers, et cetera, from being at the end of the levers, because the ends are joined together as a nut cracker usually is. We think it an answer to the contention that in both plaintiff's and defendant's devices the cutting disks and rollers are mechanically at the end of a lever, and, if that be true, it makes no difference where the alleged infringer chooses to put his fulcrum; the 'end' of the patent means, in common language, the 'business end.'"

Design Patents for Neckties

DESIGN patents are intended for inventions whose purpose is ornamentation. If the novel element, however, is hidden when in use, can it be ornamentation and can you get a valid design patent? Such was the point raised by the Gropper Knitting Mills, Inc., defending an infringement suit brought by the Franklin Knitting Mills, Inc. The novel element in the tie is a "merrowed" edge on the ends, which, of course, are hidden when the tie is worn with a waistcoat.

"That the novel element in the design is hidden, if a waistcoat is worn, is immaterial," Circuit Judge Mack decides. "Ties are marketed as such; they are bought, not only because of their utility to the wearer and their attractiveness to others when worn, but also because of the appeal, as novel, ornamental, and pleasing, that the design makes to the esthetic sense of the purchaser, ofttimes the wife, sweetheart, or female relative of the man who is to wear it.

"That sense may be favorably or unfavorably aroused by the appearance of the tie in the box or in the hand, entirely regardless of the fact that the, or one of the, attractive elements may be concealed when worn."

An injunction and accounting are granted.

BODY-MEASURING DEVICE.—Constructed to permit one to take the measurements of one's own torso, legs and arms without the aid of another person. Patent 1612637. S. Mesterton, P. O. Box 475, Rye, N. Y.

TICKET-HOLDING DEVICE.—For use upon the backs of railway car seats, for releasably holding passenger tickets in right and conveniently accessible. Patent 1612680. W. W. Vosburgh, 93 4th St., Troy, N. Y.

TOOTHBRUSH.—Adapted to be supported on and manipulated by the finger, a suitable fabric holding the cleaning compound, may be discarded after one use. Patent 1611510. E. A. Brown, 1047 9th St., Santa Monica, Calif.

SKYLIGHT.—Which is strong, and of a fire-proof construction, the glasses resting in downwardly and outwardly inclined positions upon opposite sides of a central ridge. Patent 1612554. S. Volk, 122 Water St., Benton Harbor, Mich.

BOAT.—Shaped to give a strong tendency to rise over waves, self-bailing and unsinkable, thus performing the functions of a pleasure and life-preserving boat. Patent 1611485. J. E. Paterson and R. C. Raynes, 1913 22d St., Santa Monica, Calif.

CLEANING ATTACHMENT FOR PASTEURIZERS.—Which may be readily attached to, or removed from the coils of a pasteurizer, the brush being dragged, rather than pushed, over the surface. Patent 1612681. E. Ward, 40 North 11th St., Reading, Pa.

FLUID SHUT-OFF.—For use with gas or other fluid supply pipes, wherein a spring closed valve is associated which may be released manually or by heat. Patent 1612,616. N. B. Creighton, c/o Albert Stines, 300 Grand Ave., Maspeth, N. Y.

FISH LURE.—Suitable for use in connection with fish-hooks, in casting or trolling operations, and adapted to simulate the movements of a frightened fish. Patent 1611644. O. Johnson, 475 Schuyler St., Portland, Ore.

TRAFFIC GUIDE BUTTON.—Which will present a brilliant surface, and may be readily applied to a street irrespective of the paving surface. Patent 1612245. C. B. Whitmore, Galena, Ill.

APPARATUS FOR SCREENING LIQUIDS.—Particularly in the cane sugar industries, for the screening of water in irrigating systems, where it is important that the water contain no impurities. Patent 1611739. H. F. Hadfield, Box 1043, Hilo, Territory of Hawaii.

CLOSED SIFTER CAP FOR CONTAINERS.—Such for instance, as powder containers, which is simple, easily operated, the parts being arranged not to readily get out of order. Patent 1613518. W. G. Kendall, 118 Market St., Newark, N. J.

CURLING IRON.—Which may be used for either long or bobbed hair, producing a long regular wave from front to back of the head. Patent 1609156. K. Conry, 6157 Walnut St., Philadelphia, Pa.

SKIRT MARKER.—Wherein an adjustable distributing nozzle is associated with a hollow standard for causing a distribution of marking material, the device will permit a person to accurately mark a skirt while wearing the same. The inventor has been granted two patents, 1609061 and 1609062. W. H. Collins, 18 Jay St., New York, N. Y.

TOOTHBRUSH HOLDER.—Which will provide a compartment for several tooth brushes, and a compartment for tooth powder and the like, both closures opening simultaneously. Patent 1613655. J. P. Hainzigianis, c/o Cutting, Phillips & Hall, 25 Broadway, New York, N. Y.

HULL CONSTRUCTION.—Permitting the employment of straight frame pieces, ribs and planking, disposed at right angles so that straight timbers may be used without bending or shaping. Patent 1613645. J. H. Crary, Broadway, corner Orchard St., Flushing, N. Y.

MARKING AND MEASURING DEVICE.—For use by estimators, by which marking and measuring operations may be carried out simultaneously and accurate estimates easily made. Patent 1613676. N. W. Raphael, 415 Summit Ave., South Orange, N. J.

WEAPON.—A combined revolver, knife and dagger assembled in such manner that the weapon which they cooperatively form may be easily manipulated. Patent 1614353. G. Ebert, Egg Harbor, N. J.

KITCHEN TOOL HOLDER.—Adapted to be attached to a wall, or kitchen door, for securely holding tools of various thicknesses, the tools being easily inserted or removed. Patent 1614342. F. W. Bleckley, 394 White St., Orange, N. J.

SINK.—Constructed for kitchen use, in which the voluminous bodies contained in the refuse are reduced in size, and bad odors prevented. Patent 1614358. P. A. Gandillon, c/o C. Chassevent, 11 Boulevard de Magenta, Paris, France.

GRAPHIC INSTRUMENT. — Wherein the writing instrument may be moved to an operative position, or to a protected, and inoperative position, and firmly held in either position. Patent 1614341. P. M. Biondo, 42 Throop Ave., Brooklyn, N. Y.

Hardware and Tools

WRENCH.—In which the working parts are protected against injury, with simple effective means for locking in any position of adjustment, and proof against displacement. Patent 1615440. J. Cottrel, West Liberty, Ohio.

FAUCET.—Provided with means for facilitating the disassembling and reassemblage of the parts to render the faucet more sanitary. Patent 1615713. B. H. McDuffie, c/o F. Waldhauer, 1721 Nostrand Ave., Brooklyn, N. Y.

Machines and Mechanical Devices

LUBRICATING DEVICE.—Particularly adapted for forcing grease into bearings or the like, under pressure. The device is of simple construction and easy to manipulate. Patent 1608797. H. R. McClish, Healdsburg, Calif.

HOOK.—Adapted for use in connecting the links of a jack plant line to the pulling elements of a plurality of reciprocating pumps. Patent 1608829. C. R. Zuver, 2924 Chester Ave., Bakersfield, Calif.

UNIFORM-FLOW SCALE.—The purpose of which is to weigh materials when they are flowing or in motion, as the flow of grain, coal or the like. Patent 1608796. W. A. Kaune, 1014 23rd St., Milwaukee, Wis.

ATTACHMENT FOR NAILING MACHINES.—Employed in the manufacture of wooden boxes, enabling a single operator to accomplish practically the same amount of work as an operator and helper. Patent 1610113. M. Whalen, 304 E. 65th St., New York, N. Y.

PRINTING MACHINE FOR WALLPAPER.—By which it is possible to print one or more colors, and also cut the paper, especially borders, without disturbing the other parts. Patent 1611039. W. Jackson, c/o Robert Graves Co., Third Ave. and 35th St., Brooklyn, N. Y.

WELL-TUBING CAGE.—Comprising a tubular body having a lateral port and adapted to be lowered in a well casing to prevent flow from the casing into the tubing. Patent 1610355. E. B. Brumfield and A. O. Hickok, 408 Peach St., Abilene, Texas.

SEPARATOR SCREEN.—A cylindrical device composed of a plurality of spaced apart pipes, especially designed for separating various sizes of fish. Patent 1610350. E. W. and G. Anderson, 1113 Valley St., Seattle, Wash.

EVAPORATOR.—A liquid receptacle having vapor and condensate outlets and heat-conducting means for the concentration of liquids in the production of sugar. Patent 1611059. G. Nicolai, c/o West India Oil Refining Co. of Cuba, Apartado 1303, Havana, Cuba.

PRESSURE CONTROLLER.—Of the class in which a valve body is connected with a piston acted upon by fluid under pressure to be controlled. Patent 1611079. O. Roschanek, c/o Messrs. Paget, Moeller & Hardy, Riemergasse 6 Vienna 1, Austria.

WAVE MOTOR.—Having an automatically reversible propeller of such construction as to reduce the cost of production and adapt it to a gang assemblage of great rigidity. Patent 1610603. L. G. Fairbank, 376 Ellis St., San Francisco, Calif.

AIR-CELL UNIT FOR OIL-FLOATING MACHINES.—For extracting metals from metallic ores, doing away with the great inconvenience caused by the rusting of bolts, and set screws, in machines commonly employed. Patent 1612625. J. M. Ferguson, 650 E. 2, South St., Provo, Utah.

REVOLVING-TOP FLAT CARDING MACHINE.—Which provides means to cause motes and short lint to be effectively removed by knives and an air blast. Patent 1612581. J. Holden, Jacksonville, Ala.

TYPEWRITER ATTACHMENT.—Which serves to mount a roll of paper in operative position to be fed under the platen and shifted as the typewriter shifts. Patent 1612230. L. M. Snyder, 738 Sheffield Ave., Brooklyn, N. Y.

MEANS FOR FEEDING ORE ELEVATORS.—Adapted to effect a substantially vertical lift of such material as ores, sand, gravel or the like, in ascending buckets. Patent 1613122. E. J. Ouellette, 406 E. 4th St., Anaconda, Mont.

PUMP JACK.—Which will apply straight vertical lift to the polish rod, thereby minimizing the wear on the stuffing box and preclude breaking of the tubing. Patent 1612886. C. O. Sams, De Noya, Okla.

MOTOR SHEARS.—The motor for driving the same constituting a part of the shears so that the entire device is portable and readily moved. Patent 1613126. A. S. Reichel, Essington, Pa.

IRONING ROLL.—Composed of a series of adjacent, individual, independently movable annular rings, all being normally in alinement, yet each capable of radial or lateral movement. Patent 1612992. C. and S. Silverstein, 90 Rockaway Ave., Brooklyn, N. Y.

MACHINE FOR FORMING TUBULAR FABRICS.—An attachment for sewing machines, for stitching together the edges of a strip of material, and forming a tubular fabric in a minimum of time. Patent 16517. (Reissue). P. Gardner, c/o H. M. Bunker Co., 56 Worth St., New York, N. Y.

MATERIAL-HANDLING APPARATUS.—Especially adapted for loading or unloading crushed stone gravel, coal or the like into or from trucks, and railroad car, or onto or from storage piles. Patent 1613308. E. L. Brandt, Box 840, Shreveport, La.

GEAR TOOTH.—Having a step construction, the working face consisting of successive sections whose contours are lines designed to make the gear rotate with uniform velocity. Patent 1613702. S. A. S. Hammar, 216 W. Broad St., Bethlehem, Pa.

Musical Devices

TENSION MEANS FOR DRUMHEADS.—By which the batter head and snare head may be adjusted independently, without effecting the tension of the remaining head in place upon the shell. Patent 1609940. O. Geisler, 6947 S. Peoria St., Chicago, Ill.

FLANGE-PIN RETAINING CLIP.—Designed for use on the several flanges of a piano action to hold the pivot pins in place and to prevent their working out. Patent 1610743. H. C. Buser, 133 Johnston St., Newburgh, N. Y.

TENSIONING DEVICE.—Adapted to be employed in connection with tuning pins for pianos, and in which the pin is held against movement after its adjustment. Patent 1615228. F. J. Marthy, 3081 Latonia Ave., Pittsburgh, Pa.

Prime Movers and Their Accessories

INTERNAL-COMBUSTION ENGINE.—A two-cycle construction which will operate with the same advantages as a four-cycle engine relative to intake of explosive gases and exhaust of burnt gases. Patent 1613990. G. B. Gerau, New Castle, Pa.

CARBURETOR.—In which the proportion of the liquid fuel and air may be automatically varied at various seeds of operation of the motor. Patent 1615111. J. S. Cuff, 167 Huntington St., New London, Conn.

FUEL MIXER FOR INTERNAL COMBUSTION ENGINE.—In which the mixing member will rotate at a maximum speed, being rotatably supported upon ball-bearings, thereby precluded from binding, and in which a flexible union is employed in the vapor intake line. The inventor has been granted two patents 1614664 and 1614665. B. E. Dyer, c/o Eastwood Beach Hotel Apartments, 811-17 Eastwood Ave., Chicago, Ill.

Pertaining to Recreation

SKI.—Having facilities for engaging the surface on which the ski rests to prevent the ski from sliding backward but without interfering with the forward movement. Patent 1613309. A. A. Casner, McCall, Idaho.

GOLF-PUTTING BOX.—A mechanism whereby the accuracy with regard to distance and direction of a person practicing the putting stroke of golf may be ascertained. Patent 1614399. A. B. Scott, Fairmont, W. Va.

TOY.—A wheeled toy that may be easily operated by a child, and which will be effective with respect to its exercising features. Patent 1614366. H. L. Hollowa, 946 Mt. Pleasant Ave., Columbus, Ohio.

GAME DEVICE.—Which may be used repeatedly for solving different and numerous crossword puzzles, offered by publications, and a wide range of word-building possibilities. Patent 1613204. E. W. Smith, 1609 Georgia Ave., W. Palm Beach, Fla.

Pertaining to Vehicles

LICENSE-PLATE UNIT.—A hinged plate of such character as to require the plate to be mutilated or destroyed in order to be removed. Patent 1610447. A. H. Humphrey, c/o W. G. Freeman, Director Sign & Signal Corp., Salem, N. Y.

AUTOMATIC SPARK-CONTROLLING MEANS.—For preventing jerking of the motor when the car is running at low speed. The device may be attached to any standard make of car. Patent 1611054. C. Mayoral, Apartado 433, Ponce, Porto Rico.

ACTUATING MECHANISM.—For motor vehicles, which operates automatically to hold the brake lever in braking position and which is constructed in the form of an attachment capable of being readily applied to existing cars. The inventor has been granted two patents, 1609627 and 1609628. J. E. Moore, 1840 Mission St., South Pasadena, Calif.

NIGHT TURNING SIGNAL FOR VEHICLES.—Illuminating the road at either side, depending upon the direction in which the driver of the vehicle intends to turn, controlled from the steering mechanism. Patent 1611708. E. I. Adolphson and W. McLean, 712 17th Ave., Honolulu, Territory of Hawaii.

STEERING GEAR FOR MOTOR VEHICLES.—Wherein motion is transmitted to the steering knuckles of the wheels by mechanism embodying the principle of a hydraulic press, effecting the turning with comparative ease. Patent 1610580. L. H. Nicholson, 402 No. Iron St., Centralia, Wash.

VEHICLE FENDER.—For preventing the wheels of a motor vehicle from rolling over a person or other object that the vehicle may have thrown to the ground. Patent 1610605. J. B. Henry, 2125 Parkside Ave., Burlingame, Calif.

CLOTHES-WASHING ATTACHMENT FOR AUTOMOBILES.—Which when filled with clothes and a suitable washing fluid will cause the thorough washing through the movement of the vehicle over the road. Patent 1611310. J. L. Grant, c/o Box 1606, Lakeland, Fla.

INDICATING DEVICE FOR AUTOMOBILES.—In the form of an illuminated hand, concealed in the rear portion of the car, to be swung into operative position for warning traffic. Patent 1611187. L. Haines, c/o McDonough County Fruit Growers' Ass'n, Colchester, Ill.

SPOTLIGHT.—Adapted to be attached to a fixed part of an automobile, the lens, reflector, lamp socket holder, and focusing device being removable as a unit. Patent 1612630. M. Goodrich, Charlotte, Mich.

DIRIGIBLE HEADLIGHT FOR AUTOMOBILES.—In which means is provided for varying the swing of the reflectors with respect to the front wheels, the moving parts being protected from dust. Patent 1611883. J. M. Calkins, Box 611, Detroit, Mich.

Designs

DESIGN FOR A LAMP PEDESTAL.—Patent 71231. V. J. Watral, 133 E. 16th St., New York, N. Y.

DESIGN FOR A COMBINED ASH TRAY AND CARD HOLDER.—Patent 71489. B. Berkowitz, 798 E. Tremont Ave., Bronx, N. Y.

DESIGN FOR A COMBINED ASH TRAY AND PIPE HOLDER.—Patent 71553. E. G. Forbes, Endicott Hotel, 81st St., and Columbus Ave., New York, N. Y.

DESIGN FOR A DRESS.—Patent 71577. T. Davis, c/o Franklin Simon & Co., 38th St. and Fifth Ave., New York, N. Y.

DESIGN FOR A COAT.—Patent 71578. T. Davis, c/o Franklin Simon & Co., 38th St. and Fifth Ave., New York, N. Y.

DESIGN FOR A PRINTED FABRIC.—Patent 71611. M. Lipsius, c/o Atlas & Bluhm, 5 White St., New York, N. Y.

DESIGN FOR AN ELECTRIC CANDLE.—Patent 71643. W. M. Kendrick, West Chatham, Mass.

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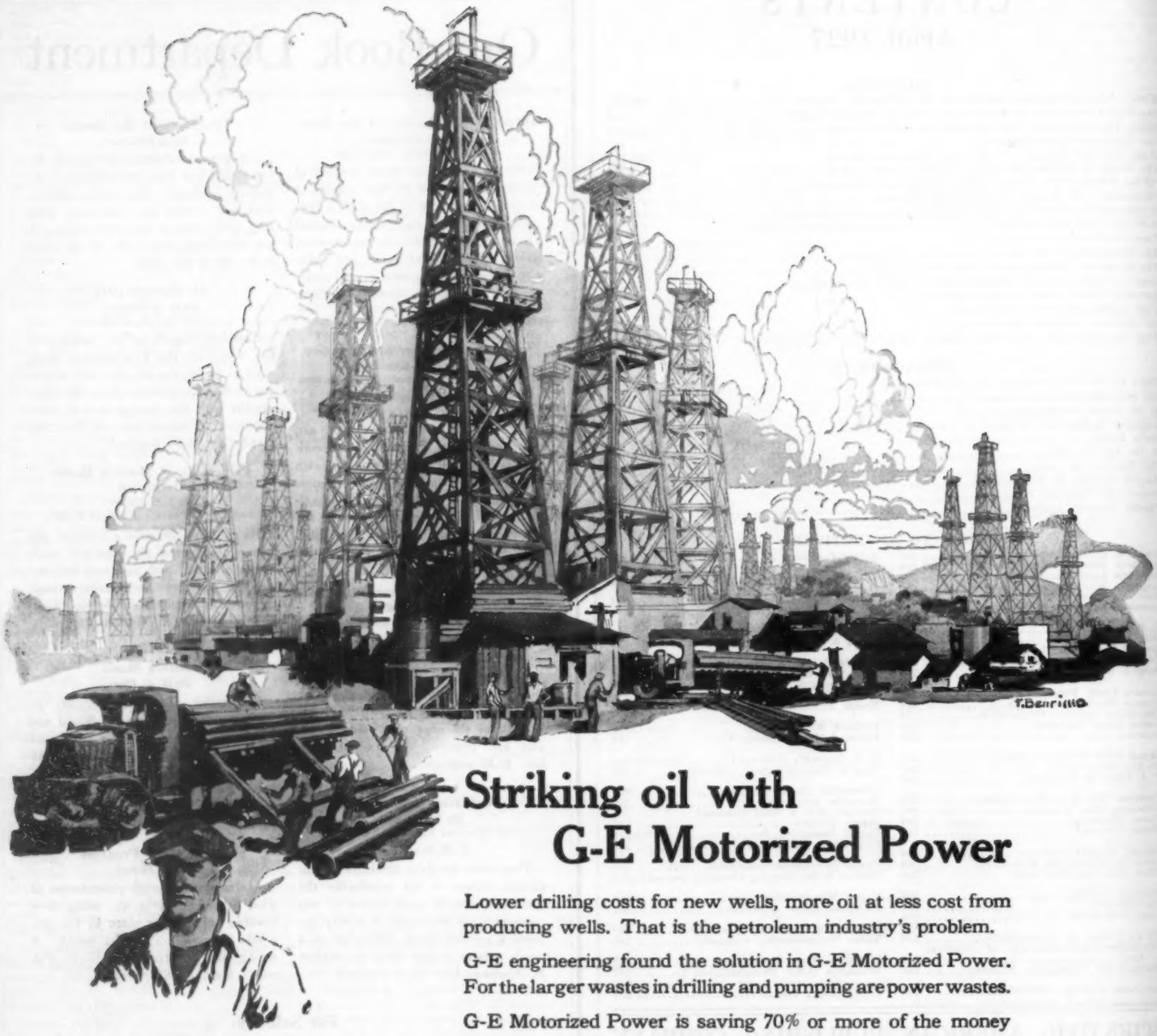

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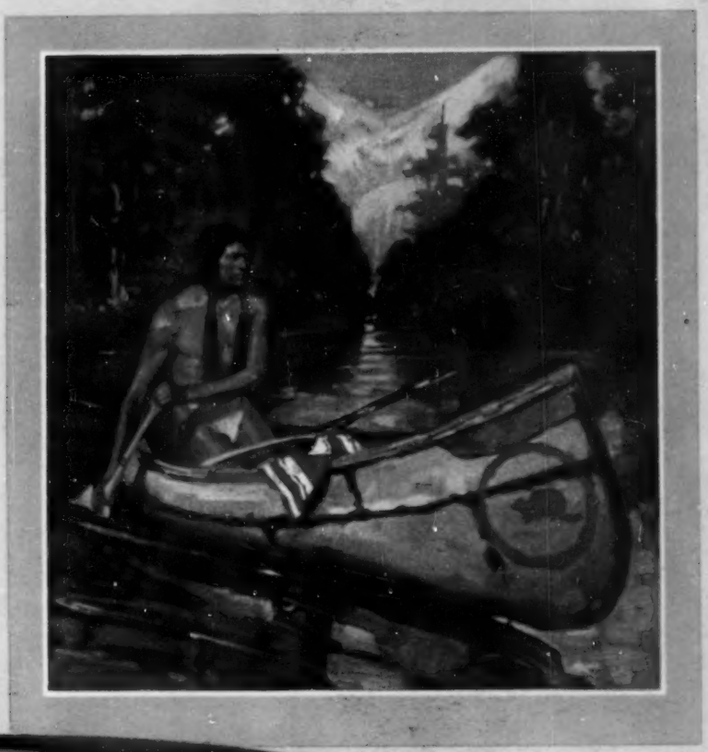

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